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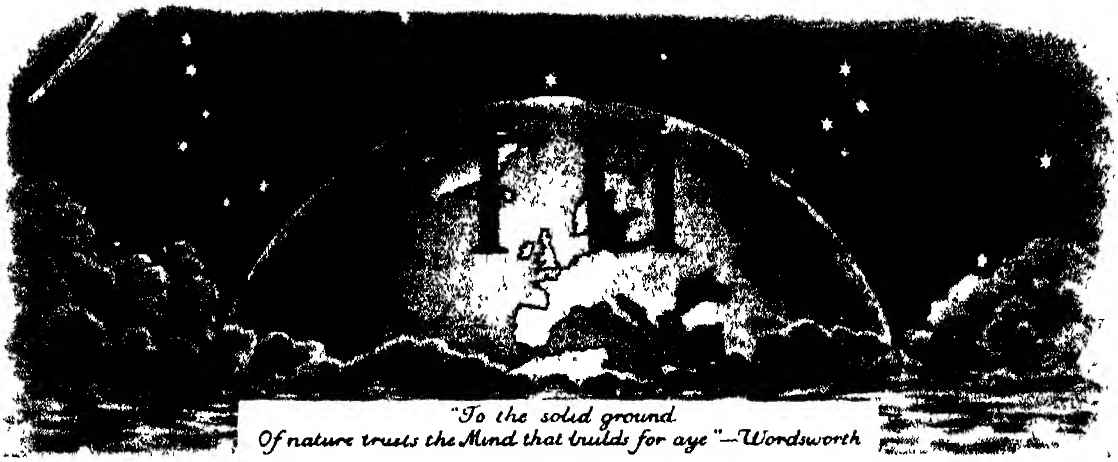

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RECONSTRUCTION IN EUROPE

EVEN in the stress and strain of the war itself, the widespread concern as to the steps to be taken to ensure that our efforts are not once again in vain is unmistakable Only the creation of a new order founded on truth and justice can compensate for the sacrifices that have to be made, and the creation of such an order involves the co-operation both of belligerents and of neutrals The extent to which this is evident is one of the most significant differences in the present temper of the nation in contrast with its entry into war in 1914.

While, however, it is well to bear in mind our failure to give effect to our purpose twenty years ago, there are to-day advantages which we did not then possess. The economic distress and confusion into which the life of Europe had been thrown would have endangered any political system. The design of the League of Nations demanded much larger ideas and sympathies than those which guided the treaty makers at Versailles, and surrender to the passions of the hour placed fatal obstacles in the way of the success of the new system. The mistakes and failures of the past are ours to profit by in the attempt to build again on ampler lines.

Nor should we write off the League of Nations as a complete failure. One of the most encouraging features of the last two decades has indeed been the success of its work in certain technical fields such as health, communications and transport, the welfare of women and children That work remains and continues, as does the work of its sister body, the International Labour Organisation, and their significance will increase

Many believe that the real weakness of the present League of Nations lies in the retention of national sovereignty. They take the view that no system of collective security can be effective unless it is part of a plan for federal government Essentially this point of view was foreshadowed by de Madariaga in 1937 in "Theory and Practice in International Relations", and more fully in his later "The World's Design". De Madariaga insists that the nations must discard the habit of thinking of foreign affairs because there are only world affairs, and that behind any machinery, such as the League or a reformed league, for world government, there must be a sufficient body of world citizens endowed with the necessary world patriotism to give world statesmen their inspiration and guidance.

It is on the foundation of a world community that de Madariaga bases his design, the building of world institutions such as a world administration to govern mandated territories, a world bank, a world trade commission and the utilization of existing international institutions, proceeding *pari*

passu with the promotion of a sense of world citizenship. In the moral basis which he advocates, de Madariaga is arguing on similar lines to Curtius in his brilliant "Civitas Dei", and his contention that, by starting with certain practical problems, the professional interest in getting a problem properly solved may gradually come to eliminate others and substitute the disinterested, rational, exploratory type of mind for the acquisitive, the dogmatic or authoritative, will commend his approach to scientific workers

Proposals of this type would conserve what is most worth while and possibly gain time for the development of a sufficiently advanced world opinion for acceptance of the idea of some form of federal government or union. This latter idea is outlined in detail in C. V. Streit's "Union Now". The general principle of a federal solution is reasonable in its fundamental premises, and many would be disposed to agree, at least in theory, with proposals to establish a federal government with supreme and single authority to use armed force against aggression by any nation or group outside the Federal Union, to control the use of raw materials in undeveloped territories now subordinate to its members, and to undertake the education of backward communities without racial discrimination.

For some such objectives as these much support could be found. The New Commonwealth, a body which has advocated the creation of an international police force, has been one among numerous factors disposing many to accept the limitations on national sovereignty involved in a federal or commonwealth solution It is in the means to be taken to achieve a federal union, and the exact extent and nature of such a union that differences of opinion arise, and the practical difficulties are much greater than Mr. Streit is disposed to admit in his facile argument for union now

Mr. Streit advocates a union of fifteen democracies of the North Atlantic, including a common citizenship, defence force, customs system, currency and postal and communication system. He urges that such a union would be so powerful in its combined resources as to assure peace to its members from the start through overwhelming preponderance and invulnerability. This number is chosen as the most practical nucleus for the organization of world government, and providing geographically, culturally, commercially, financially, politically, and historically, a cohesive nucleus. A start with the democracies is essential, because Mr. Streit proposes to base it on individual citizenship and not on the State itself as unit.

From this start Mr. Streit contemplates the growth of the Union into universal government by peaceful accession to its membership and by co-operation from the start with non-members Despite, however, the force of Mr. Streit's contention regarding the rich heritage of the democracies in freedom and justice, we may well feel that he is unduly optimistic in arguing from American or Swiss experience as to the rate of progress in achieving such a federal union, and this view is not dispelled by his brusque treatment of the way in which the problems of a common defence force, currency, customs and postal systems are to be solved. Apart altogether from such details, there are other opinions as to the extent of federalism which should be our immediate objective, and the wisdom of scrapping entirely the experience and organization already obtained in international co-operation.

Mr. Streit's plan for union is based essentially on community of ideas and interests. An alternative to this is the Continental basis, essentially as advocated by Briand in his proposal for a European Union, though here also there is some community of ideas. Briand's plan, which lapsed largely through the refusal of Great Britain to link her fate with that of the Continent, has been revived in essence in the European Federation recommended by Count Coudenhove-Kalergi, who visualizes the world as moving towards a large group system. The Pan-American Union being organized by the United States and the Soviet Union are already examples, and a great Mongol block in the Far East is possible in the future. The peoples who care for justice, international law and the rights of men must work for the organization of Europe on good principles and under democratic influences, or that organization will be done by other hands.

A European federation might be easier to secure than the union advocated by Mr. Streit, and involve less risk in attaining it. The attitude of Great Britain will be as decisive a factor in achieving the United States of Europe as the attitude of the United States of America would be in the establishment of the Union of Mr. Streit's plan. What is most important, however, at the moment is not the choice between one plan and another, but the careful and impartial examination of the problems which have to be faced by any system of union, whatever the powers it bestows on the Federal Government.

A main argument for Mr. Streit's plan is that the peoples embraced in his Union are all with long experience of Parliamentary government, and that their economic strength and command of essential materials would be able to assure peace Count Coudenhove-Kalergi contends that this in itself would be a provocation to the non-democratic powers and would facilitate Germany's dream of creating a federation in Central and Eastern Europe in which she would play the part Prussia played in Bismarck's German federation. His plan would offer Germany and Italy a place in the federated Europe, and while their claims to domination would be resisted, the whole of Europe and a great part of Africa would be their living space

Unquestionably a Europe organized on a basis of close co-operation between the several States would provide peaceful and constructive opportunities for the varied elements in Germany Co-operation between such a federation and the Pan-American Union could scarcely fail to secure the peace of the world.

A major difficulty will, of course, be the safeguards to be provided against a repetition of aggression. It is for this reason that we must think of the settlement after the present war not simply in terms of ideals or of military or political force, but as an essentially practical problem—that of utilizing to the maximum the enduring moral and constructive forces which already exist and applying them to the changing conditions as well as supporting them with adequate combinations of force. This factor alone should render us chary of discarding too readily the League of Nations, and should induce us to examine rather more carefully than Mr. Streit has done the causes of its failure or impotency.

Mr. Streit's examination of the League is somewhat warped by preconceived ideas. The League and a federal system are not, as he assumes, necessarily opposed ideas. The League Covenant, for example, lays heavy limitations on national sovereignty, and under it the way is open for gradual and successive further surrenders of national sovereignty until an effective federal scheme is built up. There is at least reason for legitimate doubt whether, if the League has failed because its member States were unwilling to observe its more moderate limitations in their national sovereignty, there is any real prospect at the present time of their entering a federal system which involves an immediate and much more drastic surrender of the essentials of national sovereignty.

Granted that the federal idea probably offers the best ultimate prospect of achieving a lasting peace, the practical question is rather the steps by which we are to advance to that position, more especially when we take into account that the evolution of the British Commonwealth, for example, so far as the Dominions are concerned, is away from any kind of union In such circumstances, it is imperative to build on any solid foundation that lies to hand.

Reference has already been made to experience and directions in which the work of the League of Nations and of the International Labour Organisation offers hope of further advance or success, and the studies or work on population questions, including migration, and on nutrition are of special promise in this respect. Beyond this we have in being to-day, in the Supreme Council and the Allied High Command, a standing organ of government with a powerful influence over two distinct Sovereign States, and a combination of armed forces under unified control. If these arrangements were kept functioning after the war, a nucleus would be provided on which an international body could be built.

If a way forward to increasingly close combination of European nations is at least possible, the forms of organization which the war is compelling us to adopt for negative purposes could equally be turned to the positive purpose of developing world resources by finding a beneficent outlet for the constructive energies of all peoples. Much progress has been made in establishing successful international commodity schemes, which form instruments of orderly development and are also powerful economic weapons. Steel, tin, zinc, aluminium, rubber, sugar, meat and other vital products are already under some form of international control. The technique of operating such controls is rapidly improving, and consumer interests are being increasingly brought to bear on their operation. This process would be assisted by the creation of an international supervisory body such as a Cartel Commission of the League of Nations, with strong personnel and powers to ensure publicity.

It is difficult to over-estimate the possibilities of such schemes. They have given the world an instrument for the scientific adjustment of expanding production to expanding consumption, thus reducing the chances of further acute world

depressions, with their shocks to the stabilizing factors in international relations. The establishment of wind-breaks against economic blizzards of the severity of those of the period of 1929–32 is essential for peaceful and orderly political development.

Moreover, world economic organization appears to be approaching the point when international finance and trade can be greatly assisted by the concerted use of new methods Internationally organized marketing, supported by international public works, might now be able to give for the first time a peaceful and lasting outlet for the world's energy comparable in scale with that which war supplied in the past Already, impartial and scientific studies of such problems, often under the ægis of the League of Nations, have provided a basis for cash and price insurance schemes for the world's farmers, measures of conservation for soil, water, fauna and flora, education and health services and modern systems of taxation in backward countries, on a scale impossible even a few years ago. Here may lie a channel the further scientific exploration of which might provide a solution of the problems of colonies and raw materials

The fact that in many fields the basis for a scientific attack on outstanding problems has already been provided is at least encouraging, and the possibilities of advance are greater than a quarter of a century ago, even if many difficulties remain. That the problems of reconstruction are already being discussed is a further hopeful sign, and evidence that the mistake of postponing until after victory in war the thought and study concerning the needs and structure of a new Europe will not be repeated Preparation for the tasks of peace cannot be left until they suddenly and urgently arise, to be dealt with in an atmosphere of bitterness, weariness and economic chaos.

There is much to be said for the immediate appointment of a body of able and far-sighted men, chosen irrespective of party attachment, to begin at once the study of this most vital problem In that study the co-operation of neutral countries should already be possible, and the way should be open for German co-operation immediately the present tyrannical leadership of that country has been replaced.

The contribution of scientific workers will be essential in the investigation of many of the problems of reconstruction which must be solved if we are to build a new Europe The scientific spirit must be an effective influence if an impartial solution is to be obtained undisturbed by prejudice or vested interests ; and scientific workers no less than other members of the community have their part to play in seeing that the problems of peace are approached now in a magnanimous and serious spirit, with the courage, vision and resolution which are essential if a new order in Europe is to pass from a dream into reality.

ISLAM'S CONTRIBUTIONS TO SCIENCE

La science arabe et son rôle dans l'évolution scientifique mondiale

Par Aldo Mieli Avec quelques additions de Henri-Paul-Joseph Renaud, Max Meyerhof, Julius Ruska Pp. xix+388. (Leiden . E. J Brill, Ltd., 1939.) 12.50 guilders.

IT is only within the last half-century that systematic investigations have been made into the part played by Islam in the development of science. Earlier estimates of its importance were mainly conjectural and thus variable, religious prejudice tending to depreciation and the principle *omne ignotum pro magnifico* to exaggeration One of the first serious attempts to set the inquiry upon a proper basis, by direct reference to original sources, was made by M. P. E. Berthelot, who in 1893 published the Arabic text of certain Muslim alchemical treatises in his "Chimie au Moyen Âge". Other very valuable pioneer work was carried out by E. Wiedemann (on Arabic chemistry and physics), M. Steinschneider (mainly bibliographical), H. Suter (on Muslim mathematicians), E. G. Browne, L. Leclerc and L. Choulant (medicine), and M. J. de Goeje (geography) More recently, Muslim chemistry and mineralogy have been closely studied by J. Ruska, H. E. Stapleton and P. Kraus ; medicine (particularly ophthalmology) by M. Meyerhof ; mathematics by Salih Zaki of Istanbul , and Muslim philosophic thought in general by Baron Carra de Vaux and De Lacy O'Leary. This list, though representative, includes only a small fraction of the large band of scholars to whom the publication of very numerous Arabic

texts—with translations, commentaries, glossaries, notes, and all the other impedimenta of learning—is due. Complementing these labours, and indeed often their condition precedent, are such monumental works of reference as the "Encyclopædia of Islam" (now successfully completed), C. Brockelmann's "Geschichte der arabischen Litteratur", and G. Sarton's "Introduction to the History of Science".

Sufficient data have therefore been amassed to make a general estimate of Muslim science both possible and desirable; and M. Aldo Mieli has now provided us with it in the work under notice. M. Mieli, as permanent secretary of the International Academy of the History of Sciences, and himself an erudite historian of science, was in a situation peculiarly favourable to the composition of such a work of synthesis Enjoying the personal friendship of the leading investigators (some of whom, namely Adnan, Brunet, Meyerhof, Renaud and Ruska, read the proofs), and editing *Archeion*—one of the principal journals devoted to the history of science—he could be sure that nothing of first importance escaped him, while errors would almost certainly be detected But though M Mieli was thus fortunately placed for his venture, and though he makes generous acknowledgments to his helpers, it is clear that the main credit for an excellent book is his alone. His material is admirably arranged, his style is clear and pleasant, and the book is well annotated, documented and indexed. It may be read without difficulty by those with a merely general interest in the development of science during an obscure period, but provides also a remarkably useful résumé for the specialist. The bibliographies, though not claiming to be exhaustive, include references to the chief authorities, and are supplemented by lists of various important texts still unpublished. an invitation to scholars which will attract new recruits while spurring on the veterans to further efforts

In the introduction to his book, M. Mieli points out that Arabic science forms the connecting link between the natural philosophy and technology of antiquity and the scientific knowledge of modern times. To exhibit his subject in the proper setting, therefore, he begins with a short but skilful survey of Indian, Egyptian and Greek science. Even in his self-imposed brevity, he finds space for a dig at the philologists who attempt to interpret classical scientific or technical terms without a knowledge of the science or art concerned. He reminds us of the familiar conception of triremes as ships propelled by three *superimposed* banks of rowers, and says that while this conception is impeccable from the philologic point of view, "un pêcheur quelconque de vos côtes aurait pourtant pu rire au nez de monsieur le philologue qui aurait voulu lui affirmer que de tels navires, si même ils avaient été construits, auraient pu naviguer". In point of fact, as was shown by Lefebvre de Noëttes in 1935, the three sets of rowers in a trireme were disposed horizontally, not vertically.

M. Mieli then proceeds to describe the rise and development of Islam, devoting special attention to the tenets of the Ismā'ilite sect, which had so great an influence upon the later character of Muslim scientific philosophy. The celebrated encyclopædia of the Ikhwān al-Ṣafā (Brethren of Purity), for example, is permeated by Ismā'ilite doctrine, while according to Kraus the works ascribed to Jābir ibn Ḥayyān were also products of the same sect In the body of the book, the author treats his subject partly by period, partly by the particular branches of science, and partly under the names of distinguished individual savants such as Al-Bīrūnī, Al-Rāzī and Maimonides. This method allows considerable flexibility and increases the ease with which the book may be read. In less adept hands, it might have led to a staccato scrappiness, but in fact its results here have been very satisfactory

After dealing with Muslim science at its zenith, M. Mieli describes the process, or rather processes, by which it was transmitted to the West. There were at first sporadic and often somewhat curious infiltrations, as for example when the merchant-turned-doctor Constantine the African emigrated from Carthage to Salerno, became a Christian, and inoculated the Salernitan School with a passion for Muslim medicine (eleventh century). More ample contacts between Islam and Latin Christianity were made in Sicily, in Moorish Spain, and through the medium of the Crusades. Countless translations were made, and countless European students sat at the feet of Muslim teachers, so that in a surprisingly short space of time the Arabic version of Greek science, together with the large contributions to knowledge made by the Muslims themselves, became immediately and universally available. By a strange coincidence, the transmission once made, Muslim civilization and science alike evolved rapidly to an irremediable decadence.

The remaining portions of the book deal with bibliographies, with certain Arabic scientists and writers posterior to the thirteenth century, and with the constitution and aims of the International Academy of the History of Sciences. The index of names is divided into three parts: (1) persons who lived before the Hegira, (2) persons living between the Hegira and the end of the twelfth century, and (3) persons living in the Christian West, since the fourteenth century. The last part includes the names of modern authorities.

E. J. HOLMYARD.

A DEFENCE OF VITALISM

Vitalism: Its History and Validity
By Dr. L. Richmond Wheeler. Pp. xii + 276. (London: H. F. and G. Witherby, Ltd., 1939.) 15s. net

MANY readers of Radl's "History of Biological Theories" and Woodger's "Biological Principles" must have been left with the feeling that biological theories are quite incoherent and biological principles non-existent. Dr. Wheeler has set himself to correct the impression left by such excessively impartial discussions. His book is a history of vitalistic theories and a defence of this point of view. It is a praiseworthy but incomplete attempt to do something extremely difficult. To complete the task satisfactorily would mean a complete history and criticism of the development of scientific thought and its varying background. As vitalism has been an attempt to supplement or set aside the traditional categories of physical science, these have to be examined first. The task is not made easier by the way that vitalists and mechanists in their age-long contest have repeatedly shifted their ground and changed their weapons. If there is a clear and permanent difference between the antagonists, it may be one of temperament as much as anything else. The mechanist is the kind of person who feels that everything important is known already, in principle at least, and that only minor details remain to be discovered. The vitalist feels that existing knowledge is only of minor details, and everything of importance is undiscovered.

The author's brief treatment of the seventeenth and eighteenth centuries is scarcely adequate for the period when the foundations of modern scientific and philosophical thought were being laid. In those days, too, the division of opinion was better defined. The vitalists really believed in 'vital forces' The mechanists really believed in the all-sufficiency of Newtonian mechanics. In fact, Hobbes believed it when the science of mechanics was scarcely more than a hope and an aspiration In the nineteenth century the controversy became more confused. The mechanists could not rely on mechanics only but had to add chemistry to their list, regardless of the fact that chemistry was an autonomous science owing very little to physical theory and called mechanical only by courtesy. The vitalists on the other side began to fight shy of vital forces and call them by other names.

In the present century the wholesale reconstruction of physical theory has made further complications. Dr. Wheeler says (p. 172): "Vitalism and mechanism are the only two types of theoretical biology yet devised and both involve the analogy of a humanly constructed machine. Vitalism allows for a mechanic. Mechanism forgets that a mechanic is essential . ." This is true enough of the traditional controversy and is still true of some of the controversialists, but not of all. If it is true, does it not condemn both sides? The analogy of a humanly constructed machine is, to put it mildly, a dangerous one and may be entirely wrong. There have not been lacking thinkers who pointed this out and for various reasons refused to take either side. Dr. Wheeler is scarcely fair to these 'cross-benchers', and tries to count them in on his side. For example, he scarcely considers the positivists at all Mach is just mentioned in passing as an anti-mechanist. It is true that positivists deny any absolute truth to mechanical theories, but they are admitted to a secondary sort of truth as "conceptual shorthand" or "convenient fictions" if they help to predict observable facts. But vitalist theories would be utterly condemned as metaphysical and of no heuristic value. Positivism, however seriously mistaken, is an interesting and influential type of theory that should not be ignored. J. S Haldane, too, is treated as a vitalist, though he always said he was not. His contention was not quite the usual one, that biology is an autonomous science with its own concepts and methods distinct from those of physics, but that the special concepts of biology are really prior to those traditionally used in physics and are really applicable to physics. If physicists have not used them, so much the worse for physics.

Dr. Wheeler sums up his discussion with a list of fourteen arguments in favour of vitalism—all those used by Driesch and several others. What is unsatisfactory about them is that they are all negative. They are designed to show that mechanism is not able to solve all problems and provide an all-sufficient philosophy. The mechanist might reply that he never said it did; he only claims that it suffices to supply all the useful information that has been or is likely to be obtained. There is no answer to this retort unless the vitalist can point to something positive on his side. Driesch's attempt was not a success because he hesitated between the old 'vital force' theory and the view that living organisms have minds, though perhaps very little ones. Neither view is necessarily absurd, nor if carefully interpreted need it contradict established facts or physical principles; but it is of no value unless it is consistently maintained, and applied in detail to specific cases.

The vitalist's demand for biology to use its own special methods and concepts can be readily granted, provided he can tell us what they are. A purely physical science like meteorology does this very thing. To-morrow's weather might be predicted by calculation using the general laws of thermodynamics and the kinetic theory of gases; but actually it is done by using purely *ad hoc* meteorological concepts and methods. If these concepts can be shown to be derived from the general theory of physics, so much the better; but if not, that is not a fatal defect. Similarly, if one wants to know the density of lead, the viscosity of glycerin or the structural formula of cane sugar, one does not find the values by calculation from the theory of atomic structure. Even if this were possible, it would take too long and give very inaccurate results. It may be suspected that results would only be forthcoming at all when the answer was known beforehand. The function of the general theory is merely to show that what has been accurately determined empirically is roughly the kind of thing that might be expected. In biology every investigator uses *ad hoc* concepts and methods while he is investigating, but as the concepts are difficult to define he may forget about them when he is arguing For this reason, the Gestalt school of psychologists have done very valuable work in producing special concepts that are sufficiently well defined, can be applied to specific cases, and act as guides to experimental investigation. If as Kohler maintains, Gestalt principles are equally applicable to physics, that is a point in favour of Haldane's view. Dr. Wheeler probably agrees to all this, but he is not very explicit about it

A. D. RITCHIE.

A USE FOR EVERY CHEMICAL

Uses and Applications of Chemicals and Related Materials
A Guide to the Current Industrial Uses, Potential Applications and Sales Possibilities of 5167 Products. Compiled and edited by Thomas C Gregory. Pp. vi + 665. (New York: Reinhold Publishing Corporation; London Chapman and Hall, Ltd, 1939.) 60s. net.

THIS is a book for which many of us have been waiting. Whilst to the more academic among chemists individual chemical substances are mainly of interest on account of their properties, the elucidation of the finer points in their structure or for use in chemical reactions, there is also a large corps of chemists who, aided by engineers, technicians, physiologists and others, are engaged in finding a useful application of as many of them as possible to the better service of humanity.

The last decade has been outstanding in regard to the discovery that all sorts of what may be described as laboratory curiosities can be made to serve useful ends. Practical work of this nature requires a peculiar aptitude which is more common in the United States than in Britain. There also the willingness of the manufacturer to try something new, because it is new, encourages such developments. The point has often been emphasized in the columns of NATURE; perhaps its reiteration at a time when war emergencies are promoting invention will serve a useful purpose.

As the sub-title indicates, the book lists in alphabetical sequence a large number of substances which can be classed as chemicals, including a high proportion of synthetic organic materials. Against each substance is listed its uses, set out under industries again arranged in alphabetical order.

For some substances the uses are already numerous; with others they are limited. It becomes possible very quickly to see whether a use has been found for a particular substance and for what kind of purpose. Thus, turning over the pages at random, ethyltriphosphonium bromide may be used as an agent for moth-proofing furs, feathers and the like as well as textiles.

Montan wax has twenty-seven uses in such diverse industries as electrical, food, ink, leather, metallurgy, paint, paper, perfumery, rubber, textile, etc., all of which are set out succinctly.

Again, orthodichlorobenzene has been applied in freeing hydrochloric acid from arsenic, as an intermediate in making dyestuffs, as a cleansing and polishing agent for brass and as a solvent in all four very varied purposes.

The collection of the material was begun in 1922 by the late Ismar Ginsburg and was continued and expanded since 1933 by Thomas C. Gregory. Most of the data have been published in the *Oil, Paint and Drug Reporter* regularly since 1922, where supplementary surveys covering additional products and new uses will continue to appear.

The practical value of the book need not be further stressed; the only criticism from the point of view of the British reader is the high cost, which will restrict its circulation here.

E. F. A.

MATHEMATICAL METHODS IN ECONOMICS

Économie théorique et statistique économique (1) Théorie mathématique de la valeur en régime de libre concurrence Par J. R Hicks Pp 56. 18 francs (2) Les fondements mathématiques de la stabilisation du mouvement des affaires. Par Prof. J. Tinbergen. Pp. 114. 30 francs (Actualités scientifiques et industrielles, 580 et 632.) (Paris · Hermann et Cie, 1937–38)

IN the classical economics of Marshall, it was assumed that a consumer spends his income so as to obtain the maximum possible 'utility', and it was deduced that the prices of commodities must be proportional to their marginal utilities. The weak point of this is that no one knows exactly what this utility is, and still less how it can be measured. Modern mathematical economists, in particular E. Slutsky, J. R Hicks, R. G. D. Allen, have, by developing Edgeworth's 'indifference curve' and Pareto's 'scale of preference', succeeded in constructing a theory of value on a new and much sounder basis. All that is assumed is that the consumer knows, of the various sets of goods purchasable for a given sum, which he likes best, which second best, and so on. It is amazing how this apparently inadequate postulate is adapted to mathematical treatment, including the use of the differential calculus to determine the maximum satisfaction obtainable with a limited amount to spend.

Consider any set of numbers the order of magnitude of which indicates a consumer's order of preference without any pretence of measuring its magnitude. These form a function of u. The most general 'index of preference' is an arbitrary function of u. The marginal utility is also arbitrary, but the ratio of two marginal utilities has a definite value, as the arbitrary factor cancels out. This ratio is called the marginal rate of substitution, and is fundamental in the new theory All the old work involving marginal utility can be employed, provided that the conclusions do not involve the arbitrary function.

One of the most important results is Slutsky's 'fundamental equation of the theory of value', which can be interpreted in terms of Marshall's elasticities Further developments include the general equilibrium of exchange and of production; but it is not necessary to describe these in detail, as the novelty of the work lies in its premises rather than in its conclusions. Prof. Hicks's tract is written for those with considerable mathematical attainments; a comparatively non-mathematical account, with extensions to a much wider field, will be found in his "Value and Capital".

We now come to a more difficult branch of mathematical economics, dealing with the case when there is a time-lag between cause and effect As a first approximation, Prof. Tinbergen makes a number of simplifying assumptions, such as that sales, profits and investments depend, not on the actual prices, wages and interest, but only on their mean values. Thus, in this 'macrodynamic approximation', production and prices are treated as a whole; the variables are really index-numbers. Moreover, certain phenomena which are considered of minor importance, such as the excess of imports over exports, are entirely ignored He now sets up a large number of equations, based partly on general economic ideas and partly on a careful statistical analysis of conditions in the United States (1919–1932). For example, one equation asserts that the mean price is proportional to the mean amount of sales nine months before, another that the rate of bank interest depends on the balance six months before.

In their general forms these equations are difficult to handle, but if we consider only variations from an equilibrium level, we get, with further approximation, a system of linear finite difference equations with constant coefficients, which are easy to solve. The solutions may be used for two purposes. First, they show how the conditions at a given period can be calculated from a knowledge of those at an earlier period. This is tested by a series of graphs, and the agreement between the calculated and observed results is much closer than might have been expected, in view of the extensive approximations made in the course of the work. Secondly, they show how the general nature of the solution depends on the values of the coefficients, and so how the magnitude of economic fluctuations can be diminished by Government action. Specific recommendations are drawn up for the consideration of the United States Government.

Lack of space compels us to pass over many extensions and applications of the author's method, such as the effect of external perturbations, of speculation, and of fixing salaries or prices. He gives a great deal of matter the importance of which may not be generally realized until it is available in a more extended form. But what seems most valuable is not so much any detail of the work as the general spirit. Physics and other sciences have made great progress because of the constant interaction between observation and theory, and it is likely that this method will prove equally fruitful in economics.

H. T. H. PIAGGIO.

SCIENTIFIC CENTENARIES IN 1940

By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.

IN looking back once again for the names of men who were born or who died, one, two, three or more centuries ago, to whom the world is indebted for some discovery, or contribution of note to the progress of modern science, the first name which stands out clearly is that of William Gilbert, the physician of Elizabethan days. He was born in 1540 When sixty years of age he published his famous book "De Magnete, magnetisque corporibus et de magno magnete tellure" This was the first great work on physical science published in England. A century or so after Gilbert died, Dryden wrote the lines

"Gilbert shall live till loadstones cease to draw
Or British fleets the boundless ocean awe."

Gilbert was born at Colchester towards the end of the reign of Henry VIII. At the age of twenty he graduated from St. John's College, Cambridge He afterwards spent some years in travel and study on the Continent and in 1569 obtained the degree of M D. Four years later he settled in practice in London and ultimately became physician to Queen Elizabeth. His home was in St. Peter's Hill, and one of his haunts was the College of Physicians, then housed in Linacre's house in Knight-Rider Street not far from St Paul's. He rose to be president of the College; and to it he bequeathed his books, globes and apparatus, but these were all destroyed in the Great Fire of 1666. He died at Colchester on November 30, 1603, and was buried in Holy Trinity Church, in which a monument was erected by his brothers.

Gilbert's experiments in magnetism and electricity mark an epoch in science in Great Britain They were fully appreciated by some of his contemporaries and Galileo, in one of his "Dialogues", makes the imaginary Salviati say of the "De Magnete": "I highly praise, admire and envy this author for having formed such a stupendous conception on a matter which has been treated by many sublime intellects, but solved by none. . . . I do not doubt that in due course of time this new science will be perfected by new observations and by true and cogent demonstrations. But the glory of the first inventor will not be diminished thereby. . . ."

Another celebrated man of science who was born in 1540, and who died in 1603, was the French algebraist François Viète, commonly known as Vieta. Born at Fontenay-le-Comte, Vendée, he was educated for the law and for some time practised at the bar in Paris. When forty years of age he was given the post of master of requests, attached to the Parliament of Paris, and from that time he gave up his leisure to mathematics. Of the three books printed during his lifetime—for private circulation—the first was his "In Artem Analyticam Isagoge" (1591); this is the earliest work on symbolic algebra. In his article on Vieta, in the old "Penny Encyclopædia", the mathematician Augustus de Morgan wrote: "If a Persian or Hindu, instructed in the modern European algebra, were to ask 'Who of all the individual men made the step which most distinctly marks the separation of the science which you now return to us from that which we delivered to you by the hands of Mahommed ben Musa?' the answer must be Vieta"

Among the French mathematicians born a century after Vieta were Jacques Ozanam (1640–1717) and Phillippe de Lahire (1640–1718). The former wrote nearly twenty books, but he is remembered to-day for his four volumes of "Recreations Mathematiques et Physiques". The youngest son in a well-to-do family, Ozanam was intended for the Church. This prospect, however, had no appeal for him, and he became a teacher of mathematics at Lyons. He there appears to have developed a passion for gaming, but some time afterwards he removed to Paris and devoted himself entirely to mathematics and was elected to the Royal Academy of Sciences. It is said that when religious matters were being discussed he remarked "that it was the business of the doctors of the Sorbonne to dispute, of the Pope to decide, and of a mathematician to go to heaven on a straight line". His contemporary Lahire was the son of a court painter and it was hoped he would become one, but geometry proved too strong an attraction In his thirties he began observing at the newly erected Paris Observatory where Cassini was similarly employed. By the Minister Colbert he was appointed to assist Picard in geodetical work for the chart of France. He wrote a variety of works and from 1690 onwards held a professorship in the famous Collège de France.

The year 1640 also saw the birth of Dr. Robert Plot (1640–96), author of natural histories of Oxfordshire and Staffordshire, a secretary of the Royal Society and the editor of vols. 143–166 of the *Philosophical Transactions*. When Elias Ashmole established the first University chemical laboratory at Oxford, it was placed under Plot's charge.

The bicentenaries which occur this year recall, among others, the names of two authors concerned with those indispensable works—encyclopædias. In May 1740 Ephraim Chambers died and was buried in the cloisters of Westminster Abbey. As a youth he had come to London from Westmorland to learn globe-making at the hands of Senex. From globe-making he turned to writing and, conceiving the plan for a dictionary of science, took chambers in Gray's Inn and there in 1728 produced his "Cyclopaedia, or . . Dictionary of Arts and Sciences". It immediately won a reputation for him and he was elected F.R.S. Several editions of his work appeared and it formed the basis of the Cyclopædia of Dr. Abraham Rees (1745–1823). In between the publication of the encyclopædias of Chambers and Rees came that of the "Encyclopædia Britannica" (1771), projected, printed and published by the public-spirited Edinburgh printer and naturalist William Smellie, who was born the year Chambers died.

The record of scientists, inventors and pioneers born in 1740 includes the names of Henry Cort (1740–1800), whose patents of January 17, 1783, and February 13, 1784, for the production of wrought iron plates, bars and rods form a milestone in the history of our iron industry; of Joseph Michel Montgolfier (1740–1810), who with his brother Jacques Etienne Montgolfier (1745–99) made the pioneering experiments with balloons; of the astronomers Thomas Bugge (1740–1815) of Copenhagen, Jacques Andre Mallet (1740–90) of Geneva, Andre Jean Lexell (1740–84) of Sweden and St. Petersburg, and of the famous geologist, physicist and mountaineer, Horace Bénédict de Saussure (1740–99) Like Mallet, de Saussure long held a chair in the University of Geneva, but it was his travels, his observations of rocks and his climbing expeditions which contributed most to his renown. His excursions culminated during the years 1787–89 with the ascent of Mont Blanc, a stay for thirteen days on the Col du Géant, and a tour of Monte Rosa. Mont Blanc, it may be added, was first climbed in 1786 by the hunter Jacques Balmat and Dr. Paccard.

Some of the eminent men of science who died in 1840 were referred to at the anniversary meeting of the Royal Society of that year. Among these was the French mathematician Simeon Denis Poisson (1781–1840); the German anatomist and naturalist Johann Friedrich Blumenbach (1752–1840) and the German astronomer Heinrich Wilhelm Matthäus Olbers (1758–1840). Olbers and Blumenbach when they died had passed the allotted span of life, but Poisson, apparently by his unceasing labour and his neglect of exercise and healthy recreation, had shortened his life. From a boy upwards he had been a prodigious worker. He was a younger contemporary of Lagrange, Laplace, Fourier, Monge, Prony and other members of the brilliant group of scientists in Paris during Napoleonic and post-Revolutionary times. He occupied positions at the École Polytechnique, the Collège de France, and the Bureau des Longitudes. "If he was inferior to Fourier or to Fresnel," said an obituary in the *Athenæum*, "in the largeness and pregnancy of his philosophical views, he was incomparably superior to them in mathematical power · if some of his contemporaries rivalled or surpassed him in particular departments of his own favourite studies, he has left no one to equal him, either in France or in Europe at large, in the extent, variety, and intrinsic value of his labours".

Five others who died in 1840 were Joseph Johann von Littrow (1781–1840), the Bohemian astronomer who from 1821 was director of the Vienna Observatory; André Jean Francois Marie Brochant de Villiers (1772–1840), who with Elie de Beaumont and Dufrenoy made a geological map of France; Nicolas Aylmer Vigors (1787–1840), the Irish M.P. who was a founder and the first secretary of the Zoological Society; Sir Anthony Carlisle (1768–1840), the surgeon who with William Nicholson on May 2, 1800, decomposed water with the aid of the first voltaic pile made in England, and Sir Robert Seppings (1768–1840), an eminent naval constructor in the days of our 'wooden walls'.

Seppings was a shipwright apprentice in 1782, master-shipwright at Plymouth in 1800, and at Chatham in 1804, and in 1813 was appointed surveyor to the Navy, a post he held until 1832. He introduced a form of keel blocks for dry docks which enabled ships to be dealt with rapidly, and a system of diagonal trussing for ships which was extensively used. In 1818 he was awarded the Copley Medal of the Royal Society for his communications on warship construction. He died at Taunton on April 25, 1840, and his monument is in St. Mary's Church.

Of men of science born a century ago in Germany one of the most notable was Ernst Abbe (1840–1905) whose optical investigations, combined with the work of the instrument-maker Carl Zeiss (1816–88) and the glass-maker Otto Schott, made "Jena glass" famous the world over and Zeiss instruments the standard of excellence. Abbe was a professor in the University of Jena at the age of twenty-six he became associated with Zeiss. After Zeiss's death he was responsible for the business, which he formed into a sort of trust called the Carl Zeiss Stiftung. Speaking at the Optical Convention of 1905, shortly after Abbe's death, Glazebrook said that "Abbe's work in Jena is perhaps the most striking illustration of the way

in which progress depends on the co-operation of science and experience". Another German physicist born in 1840 was Friedrich Kohlrausch (1840–1910), the successor of Helmholtz and the predecessor of Warburg, as president of the Reichsanstalt at Charlottenburg. In France 1840 saw the birth of Emile Duclaux (1840–1904), an early assistant to Pasteur, who after his master's death became director of the Pasteur Institute.

Sweden has long been famous for its chemists and metallurgists, and among the former are Lars Fredrik Nilson (1840–99) and Per Theodor Cleve (1840–1905). Both studied at Uppsala, both held chairs there and at Stockholm and both were elected foreign members of the Chemical Society. The memorial lecture to the Society on Nilson was given by Prof Otto Pettersson and that on Cleve by Sir Edward Thorpe. Speaking of the position Sweden occupied in relation to chemistry, Thorpe said that "when regard is had to her position among continental nations—to her chequered political history, to her geographical isolation, the comparative sparseness of her population, her relative poverty, the fewness of her seats of learning—the influence which Sweden has been able to exert on the development of that branch of science, which it is the proper function of this Society to foster, must always excite our wonder, admiration and gratitude. The mere mention of the names of Bergmann, Scheele, Berzelius, Mosander, Gadolin, Nilson, is sufficient to remind us how great have been her services to the science of chemistry".

To this necessarily incomplete list of men distinguished in science, invention or engineering may be added the names of the American geologist Edward Drinker Cope (1840–97); the American-British inventor and engineer Sir Hiram Stevens Maxim (1840–1916); the Irish astronomers Lord Rosse (1840–1908) and Sir Robert Stawell Ball (1840–1913); the Scottish inventor John Boyd Dunlop (1840–1921) of pneumatic tyre fame, the English metallurgist James Riley (1840–1910), and the great civil engineer Sir Benjamin Baker (1840-1907), whose name will always be remembered in connexion with the Forth Bridge, the Aswan Dam and other important constructions. Baker was elected F.R.S. in 1890, and served as president of the Institution of Civil Engineers in 1895. He died at Pangbourne on May 19, 1907, and was buried at Idbury, in the Cotswolds. On December 3, 1909, a memorial window to him was unveiled in the north aisle of the nave of Westminster Abbey.

FOOD FROM GARDENS AND ALLOTMENTS

BY SIR JOHN RUSSELL, F.R.S.,
ROTHAMSTED EXPERIMENTAL STATION

THANKS to numerous official inquiries, the quantities of food required by the population of Great Britain are fairly well known. Our diet is both generous and varied. The total food consumption averages rather more than 900 lb. a head without counting milk and eggs. Apart from these the *per capita* consumption falls into five groups: about 200 lb. each of (1) wheat, (2) potatoes, (3) other vegetables and fruits, and (4) meat and fish combined; (5) some 140 lb. of other foods, chiefly sugar (94 lb.) with smaller quantities of butter (25 lb.), margarine (8 lb.) and cheese (10 lb.).

We produce at home all the potatoes, the liquid milk, and much of the vegetables; about half the meat and fish, but only 15 per cent of the wheat and some 10 per cent of butter. We produce rather less than 40 per cent of the total money value of our foods, and rather less than 50 per cent of the total weight. On an average, for each individual there is in peace time an import of about 4 cwt. of food per annum.

One of the most urgent problems at the present time is to reduce this figure It is made up roughly as follows:

Wheat	$1\frac{1}{2}$	cwt
Meat and fish	1	„
Fruit, butter, cheese, etc	1	„
Sugar	60	lb.
Total	4	cwt. approximately

The largest item is wheat, of which 170 lb. is imported out of the 200 lb. consumed. We shall, however, produce more. The plan of the Ministry of Agriculture is to plough up two million acres of land in all; in the War of 1914–1918, when this was nearly accomplished, we had added 50 per cent to our wheat production.

If we succeed in doing as much this time, we shall reduce the 170 lb. of imports to 155 lb., but it seems scarcely likely that we can get much below this. Something could be saved by closer milling, but that would only mean less food for our animals and therefore less meat and milk. For one thing we have insufficient land available;

wheat is one of the least economical of all crops to grow so far as land is concerned, for while 1 acre of wheat suffices only for 6–7 persons per annum, 1 acre of potatoes suffices for 70–75.

For meat and fish our imports are about 110 lb annually out of a total consumption of practically 4 lb. per week per head. Consumption could be cut down by rationing; but in view of the circumstances that our animal population is now larger than it has ever been before, it seems improbable that there will be much shortage during the first year of the War Even our animals, however, have been living on imported food, though not to the same extent as ourselves, Dr Wright recently estimated that some 25 per cent of their total food is imported

The area of land being limited, all increased allocation of land for human food means a reduced area for the growth of food for animals During the War of 1914–1918 the annual production of milk fell by 400 million gallons, a reduction of 20 per cent, while that of meat fell by 170,000 tons, a reduction of 17 per cent. There were various contributory causes and we shall hope in this War that the fall will not be so great. In seeking to increase production of human food we must not, however, forget our animals.

The import of fruit will be difficult to replace. The Englishman's favourite fruits are bananas, oranges and apples, and two of these must be wholly imported while of the third we produce only a fraction of our total consumption.

Another big item in the import bill is sugar; the 60 lb of import can be cut down by rationing; we can produce more at home than we are doing and we shall, it is hoped, also make better use of bees. From a reasonably well-kept hive one should obtain some 40 lb. of honey, though this is not a net gain because it involves the feeding of some 10–20 lb of sugar to the bees. On dairy produce we cannot hope to save much If there were no waste the ration of ¼ lb. of butter per week would give us 13 lb a year, not far short of the 16 lb. which was our average until recently

The most hopeful direction of saving shipping is therefore to economize on meat, fruit and sugar, at the same time increasing our home production of wheat and also of animal food so as to avoid the necessity for reducing home production of milk and of meat.

The question to be decided then is: What part can gardens and allotments play in this programme of production?

Experience in the War of 1914–18 shows that production of potatoes can be readily expanded and with great advantage in every way. The production rose in the last war from 7·5 million to 9·4 million tons—an increase of nearly 25 per cent. Potatoes are not only valuable as food for men and for animals, they are also an important source of starch for various other purposes. They are easy to grow and responsive to treatment.

Vegetables will become of increasing importance as the meat ration is cut down; but unfortunately, while the English gardener can produce them at least as well as anyone else, the English cook usually treats them deplorably. The great difficulty about reducing our meat ration will be that we may be presented with a succession of vegetarian dishes, made dull and tasteless, not through any fault of the vegetables, but because of the incompetence of the cook. For this reason it is very important in any garden or allotment that there should be as wide a variety as possible of vegetables, including particularly those used for salads, and those that can be made up into tasty dishes. Food value is probably of less importance than tastiness, it seems improbable that our dietary would ever be so seriously curtailed as to be lacking in actual food value, the present danger is that it may lack variety and no longer be appetizing. This the gardener should seek to remedy

It seems inevitable that sooner or later we must face a reduction in the amount of fruit that we usually import; we can scarcely hope to continue our present supplies of oranges and bananas and imported apples. In many gardens there are fruit trees and bushes in a more or less neglected condition If these were overhauled they might be made to yield better during the coming season; the produce may be very welcome, for the deficiency of fruit must somehow be made good both by growing more at home and by using more vegetables.

The increased garden production of potatoes and vegetables would have several important advantages quite apart from ensuring supplies for the grower's table. Farm land now used for the production of potatoes and vegetables could be released for other purposes, especially for the production of fodder crops for animals, thus saving the necessity for uneconomic slaughter and ensuring continued milk and meat production.

Much internal transport could also be saved. At the present time many parts of Great Britain are not self-supporting in potatoes and vegetables, and considerable quantities have to be transported from county to county, occupying valuable truck space or using up petrol on the roads. It would be a great advantage if this internal transport could be cut down.

The possibilities of increase are considerable. It is estimated that there are some 3½ million gardens and 900,000 allotments in the country. The Ministry of Agriculture is stimulating the formation

of new allotments, aiming at establishing another 500,000. Many of the existing gardens and allotments are not, however, fully used, and it is desirable to improve them as speedily as possible. Technical advice is now available in every county. There is, however, a real danger of considerable waste of seed and manure, neither of which can well be spared now. Here there seems a useful opening for local distribution that could ensure distribution of manure and interchange of seedlings so as to avoid the present wasteful methods. Distribution of excess produce is another important problem, for however well the garden is planned it is impossible to avoid an excess at one period and a deficiency at another. Unfortunately, organization of garden production is peculiarly difficult and in the past has rarely succeeded, but that is no reason why it should not again be attempted, as in the last war. Finally comes the important question of utilization of garden wastes; the best way, the keeping of pigs and poultry, is not usually possible In any event, even if these are kept, the compost heap is an essential part of a good gardener's equipment.

THE EARTHQUAKE IN TURKEY

BY E. TILLOTSON

THE greatest earthquake ever recorded in Turkey, and probably the greatest natural catastrophe which Turkey has ever suffered, occurred on December 27, when, between approximately 1 57 a.m. and 5 a m local time (East European), there were at least seven terrific earthquake shocks. These shocks caused havoc on and near the Black Sea coast of Anatolia in northeastern Turkey, where, to the accompaniment of underground rumbling, upwards of fifteen towns having populations of between fifteen and forty thousand persons each, together with more than ninety villages, were practically razed to the ground, communications by telegraph, road and rail destroyed, and estimated casualties of 45,000 killed and 20,000 wounded caused

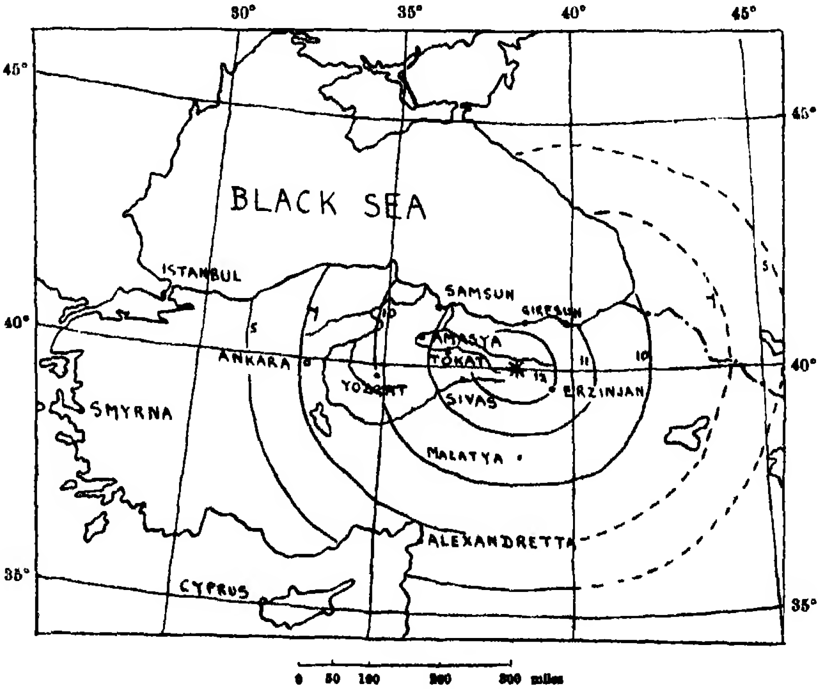
The first news of the catastrophe was received from the Bendandi Observatory at Faenza, which reported that an earthquake of catastrophic dimensions was registered on its seismographs at 1 a.m. (Mid-European time). The earthquake was estimated to have taken place in Armenia, and the vibration at Faenza was so intense that the recording instruments were damaged. Similar news came from the Swiss observatories, and at Zurich the shock was received at 1.2 a.m. (Mid-European time). The seismograph belonging to Mr. J. J. Shaw at West Bromwich was also damaged by the earthquake, though Mr. Shaw was away from home at the time. Shortly after the news from Faenza, messages were received from Ankara stating that earthquake shocks had been experienced there

The full force of the principal shock was felt at Erzinjan, a town situated at an altitude of 4000 ft. above sea-level where a brisk trade was conducted in silks, cotton and copper. The town was immediately reduced to a heap of ruins and about 80 per cent of the population killed The upsetting of oil lamps and stoves and the breaking of gas pipes caused hundreds of fires to break out in all parts of the town, which the surviving brigades could not extinguish on account of broken pipe lines and huge cracks in the roads Telephone and telegraph communications were also disrupted. Here, included in the wreckage, were the military barracks and club and military school, where ten officers and ninety cadets are known to have lost their lives, though a much greater military death roll is feared. Damage only a little less severe was done at many other towns Sivas, a town of 65,000 inhabitants, the centre of caravan routes and a collecting place for the agricultural produce grown in the surrounding districts, together with Tokat in Sivas Province, a town of 31,000 inhabitants engaged largely in calico manufacture, and the intervening villages, were practically wholly destroyed. Many people, in bed at the time of the first shock, were buried alive in the wreckage of their homes. The district of Kemah, the town of Yozgat and the town of Amasya, with a population of 30,000, in the midst of fruit-growing country, are all in ruins. At Samsun in the Trebizond district, a seaport with a population of 15,000, exporting copper, timber, tobacco, wool and other agricultural products, mosques, minarets, schools and public buildings—some of them built of reinforced concrete—and private houses came crashing down, killing thousands of people. Ordu, in the tobacco-growing district, suffered similarly, as did also Giresun, Malatya, Turhal, Gumushane, Refahive and Plumer. On the night of December 28 fires were still blazing amidst the ruined buildings, and to add to the difficulties of the rescue parties a blizzard was raging in the countryside at a temperature of 2° F. Of the 350 inhabitants of

the village of Tomruk, only three survivors have been traced. The single-storied mud houses of the peasants suffered terribly.

The first relief train on the recently opened Sivas-Erzerum railway was held up just outside Sivas because of wreckage on the line, twisted rails and huge ground fissures Most of the geological faults already known in the area have moved, causing large crevices and permanent lateral movement. One of the principal faults along which movement has taken place has been estimated by the director of the Istanbul Observatory to be sixteen miles deep, and many new faults have been formed.

On the basis of the macroseismic data, the accompanying sketch map showing the isoseismal lines has been constructed. The scale used is the modified Mercalli scale of 1931 originated by H. O. Wood and F. Neumann for the Carnegie Institution of Washington and the United States Coast and Geodetic Survey. This scale is numbered 1–12 in ascending order of earthquake intensity, 1 being a shock not felt except by a very few under especially favourable conditions, and 12 being a shock where the damage is total, waves being seen on ground surfaces, lines of sight and level distorted and objects thrown upward into the air. It is extremely rare for a shock to have intensity 12, though many of the great earthquakes described by Davison, and the Chilean earthquake of January 24, 1939 (NATURE, February 11, 1939, p. 230), probably exceeded scale 11, which indicates *that few if any masonry structures remain standing*, broad fissures exist in the ground, underground pipe lines completely out of service, and rails bent greatly. Scale 7 indicates that damage has been negligible in buildings of good design and construction but considerable in poorly built or badly designed structures, whilst scale 5 shocks are felt by nearly everyone, break some dishes, crack some plaster and overturn unstable objects. It should be noticed that such intensities are influenced by ground conditions as well as by the energy causing the displacements, and, since buildings once cracked may succumb to prolonged shaking, the total period of shaking would appear to be an important factor.



SKETCH MAP SHOWING THE APPROXIMATE EPICENTRE AND ISOSEISMAL LINES (MODIFIED MERCALLI SCALE OF 1931) OF THE ERZINJAN EARTHQUAKE OF DECEMBER 27, 1939.

*, EPICENTRE; —10—, ISOSEISMAL LINE.

The greatest of the shocks was certainly world-shaking so far as modern seismographs are concerned, since these are capable of registering measurable ground displacements of less than 5 μ (where μ = 0·001 mm.). It was registered at observatories throughout the British Isles and in the world in general. The fact that seismographs as far away from the epicentre as West Bromwich which were set for normal earthquakes were dis-

located appears to show that the surface waves L and M as distinct from the body waves P and S were of very large amplitude, indicating the release of a tremendous amount of energy from a normal or shallow focus This also appears to be confirmed by the relatively quick decrease of destructiveness in all directions moving away from the epicentral area The news from Istanbul Observatory also appears to indicate that the greatest focal depth of any one shock was sixteen miles

The principal shock is estimated to have shaken the devastated area for a period of some twenty seconds, though seismograms from distant observatories occupy a much longer period of time on account of the variation in velocity of the different waves sent out by the earthquake. The epicentre of the principal shock appears to have been near latitude 40° N , longitude 38·5° E. and the initial time of the first shock about 1.57 a.m. local time (East European) or 26d. 23h 57m G.M T. It must not be thought that all the seven or more shocks originated at the same time or from the same epicentre, as there is evidence to support the hypothesis that the epicentres of the shocks wandered east and west along latitude 40° N , the first being some seventy miles east of Ankara, and later southwards along approximate longitude 39° E Also it appears to be more correct to speak of an epicentral area rather than an epicentrial point. Aftershocks have continued to be numerous and severe. These, too, appear to be peripatetic along the lines above mentioned, and as yet the diminution according to the usual exponential law does not seem to have become evident. Shocks were still occurring up to December 31, and on that date a violent shock was reported at Bergama, on the Ægean coast

On December 31, serious floods followed the earthquakes. These have caused further casualties and damage to houses and communications. It is now estimated that the entire population of Erzinjan, Trebizond, Tokat, Sivas, Ordu, Samsun and Amasia, totalling about two millions, are without shelter.

More than five hundred villages in the Brusa region have become marooned, and the Izmid Gulf area is totally submerged. Intermittent, though less intense, shocks occurred in eastern Anatolia on January 1. On the same day, the towns of Karacabey, Manyas and Yenisehir became inundated by the flood water, and the Rivers Nilafur, Halife and Karadere changed their courses. More villages were marooned later in the day.

It is estimated that the devastated area covers about 15,000 square miles, which is about one twentieth of the country.

A third disaster occurred on January 1, when severe storms broke out over the Black Sea causing serious damage to shipping.

On January 2, the floods became more extensive in western Anatolia, where the Sakarya River overflowed and flooded the Bilecik valley. Light tremors were still occurring.

It has been noticed previously by Dr C. Davison and the late Prof. H. H Turner that violent earthquake shocks appear to be followed almost immediately by sympathetic shocks in various parts of the world and often at the antipodes. It may be that at these places where sympathetic earthquakes occur there already existed a state of tension (or compression) in the strata and 'layers' which almost amounted to unstable equilibrium, and that it only needed the trigger action of another shock in lieu of some other factor to release the energy and produce the sympathetic earthquake. The Anatolian shock was particularly violent, and therefore it was no surprise to find earthquakes occurring in other parts of the world On December 27 about 7 a.m., San Salvador in Central America, near to which there was an earthquake on December 5, experienced earthquake shocks, as did Los Angeles in California on the same day. These are both reported to have been strong shocks, though no damage was reported Between December 27 and 28, twenty-five earthquakes and earth tremors, two of which were of sufficient intensity to rattle crockery though none did any material damage, shook the gold-mining district of the Rand near Johannesburg in South Africa On December 27 also, at Tangier, the north African port, deaths were reported as being due to a strong earthquake there Previously, in 1784, Erzinjan was devastated by a severe earthquake, though the shock does not seem to have been so severe as on the present occasion

It must be remembered that the whole of Asia Minor is a seismic zone for small shocks, as is seen by the fact that Miss Bellamy has catalogued 280 shocks as having occurred in and around Turkey between 1913 and 1930, though earthquakes in this region appear to have been stronger and more numerous of late (prior to the present shock) On September 22, 1939, two hundred people were reported killed during an earthquake which occurred in the Smyrna district (NATURE, September 30, p. 589). Damage and casualties occurred also in the villages of Pergame, Kotchili and Fotcha. Then so recently as November 23 last, an intense shock destroyed six villages in Anatolia (NATURE, December 2, p. 938), killing forty-three people besides injuring many more

Further news of the present disaster must await the restoration of communications in the afflicted area, and the careful study of the seismograms in observatories throughout the world.

THE PALAO TROPICAL BIOLOGICAL STATION

By Prof. C. M. Yonge,
Department of Zoology, University of Bristol

THE history of the investigation of coral reefs reveals the fascination these unique marine communities have exercised over the imaginations of zoologists. One thinks of Darwin at Cocos Keeling, of Dana on the United States Exploring Expedition, of Murray on the *Challenger*, of Alexander Agassiz who sailed over all tropical oceans, of Gardiner and Sewell in the Indian Ocean, of Mayor at the Tortugas and at Murray Island and Samoa, of Crossland in the Red Sea and in Tahiti. In more recent years exploration and description have given place to studies of a more physiological nature, and research has been localized around permanent or temporary marine laboratories. Mayor led the way at the Tortugas and was followed by the Dutch at Batavia, by the Great Barrier Reef Expedition at its temporary laboratory at Low Isles and by the University of Egypt on behalf of which Crossland established the marine laboratory at Ghardaqa in the Red Sea.

Now a new centre of research has been established by the Japanese on Korror Island, one of the Palao (Pelew) group situated in the western Pacific some eight degrees north of the equator. The Palao Tropical Biological Station owes its inception to the activities of the Japanese Society for the Promotion of Scientific Research, the site of the station being selected by Prof. Shinkishi Hatai of the Tôhoku Imperial University, Sendai. The Laboratory, which was opened in April 1935, consists of a series of single-story wooden huts admirably suited for work in the tropics. It is surrounded by water which varies in temperature only between 28° and 31° C. and is rich in coral. Since its establishment a continuous stream of biologists have been sent to the Station from Japan and the results of their work are contained in the pages of the *Palao Tropical Biological Station Studies*, the first volume of which has recently been completed

The most important sections of this work are concerned with corals. No fewer than 116 species, belonging to 43 genera, have already been identified, and these are listed in a systematic paper by M. Eguchi This number compares with 117 species of 41 genera recently reported by Umbgrove[1] from the Bay of Batavia, probably the scene of the most intense collecting in the tropical Indo-Pacific.

Dr. Noboru Abe, of the Asamushi Marine Biological Station, contributes a series of papers dealing with the unattached coral, *Fungia actiniformis* var. *palawensis*. The eggs are fertilized while still in the gonad and therein develop into planulæ. These are liberated about the time of new moon every month from September until April, a condition which recalls the similar regular planulation of *Pocillopora bulbosa* recorded by Marshall and Stephenson at Low Isles[2] Post-larval development is described and figured, the animal being capable of capturing active copepods about the fifteenth day In a later paper the feeding reactions and nematocysts of this and fifteen other species of corals are described Valuable observations on tentacular and ciliary feeding are recorded, the general conclusions supporting those of Yonge[3] that corals are specialized carnivores feeding on zooplankton. Ecological studies revealed that this species is widely distributed in regions of still water on sandy areas where it is frequently aggregated in large numbers together. Abe analyses the causes of this distribution in a paper dealing with migration and righting actions He confirms the observations of Marshall and Orr[4] that Fungia is capable of uncovering itself when buried under sand while he also reveals that it can right itself when turned over. This reaction, as well as uncovering, are due to expansion of the disk tissues high above the underlying skeleton. The same phenomenon has been recorded by Yonge[5] in *Maeandra areolata*, the unattached meandrine which occupies a similar habitat in the Atlantic The aggregation of Fungia is explained by the action of tidal currents which carry them into areas of still water where sand collects between coral patches Work on the biology of these unattached corals reveals the great powers of adaptation possessed by Madreporaria.

Abe also describes the expansion and contraction of the polyps of *Caulastræa furcata* which, like the great majority of reef-building corals, expands only by night. Expansion has no relation to food, zooplankton supplied by day failing to induce it. Abe associates expansion by night with the greater need for diffusion of carbon dioxide when this is not removed by the photosynthetic action of the zooxanthellæ. He found that expansion occurs by day when oxygen tension is low and that of carbon dioxide is high. But actually it is contraction during the daytime—a condition not found in the

other Anthozoa—which requires explanation, not expansion by night Nevertheless Abe has broken new ground in this work which will contribute to the eventual solution of this problem.

In a series of papers on the physiology of reef corals Kawaguti confirms the observations of Yonge, Yonge and Nicholls[6] on the oxygen consumption of corals in relation to its production by the zooxanthellæ, and adds important data on the effect of light on pigmentation and growth. Upward growth of corals is all-important in the formation of reefs, and Kawaguti states that all reef-builders containing zooxanthellæ, which he examined showed positive phototropism The presence of glycogen, small amounts of a reducing sugar and copper in Fungia has been determined by Hosoi. Hayasi has entered the controversy concerning the mode of formation of the skeleton and decided that the calicoblasts are the ectodermal cells themselves, not specialized cells derived from these, which secrete the calcareous lamella, including the organic matrix, as an extracellular product Other papers deal with animals associated with corals, and include observations by Hiro on the gall-crabs, Hapalocarcinus and Cryptochirus, and on cirripedes which grow on corals. A long paper by Matsuya is concerned with the hydrography and plankton of the waters of Iwayama Bay

Enough has been said to reveal the range and interest of the work being carried out at the Palao Tropical Biological Station. The work of Prof. S Hatai has long been known in connexion with his direction of the Asamushi Marine Biological Station and the numerous papers published by him and by his pupils in the Science Reports of the Tôhoku Imperial University He is sincerely to be congratulated on the work of this new tropical marine station which he instituted and the activities of which he has since directed with such conspicuous success

[1] "Zool Mededeelingen", Leyden, **22** (1939)
[2] Sci Rpt G Barrier Reef Exped, **3**, No 8
[3] Sci Rpt G Barrier Reef Exped, **1**, Nos 2 and 3
[4] Sci Rpt G Barrier Reef Exped, **1**, No 5
[5] *Pap Tortugas Lab*, **29**, 187 (1935)
[6] Sci Rpt G Barrier Reef Exped, **1**, No 8

OBITUARIES

Prof. Ernest A. Gardner

THOUGH unable latterly to take active part in the studies to which he had contributed much, Prof. Ernest Gardner, who died on November 27, aged seventy-seven years, will be remembered in the University of London as the creator of a vigorous department of classical archæology, and as a stimulating teacher, as well as for his administrative services as Dean of the Faculty of Arts (1905–9 and 1913–15), and as Vice-chancellor in 1923–26. After a distinguished Cambridge career, he went out to Greece in 1886 with a fellowship of Gonville and Caius College, and a Craven Fellowship, as the first student of the newly founded British School of Archæology at Athens, of which he became director in the following year. He had already done a season's excavation at Naucratis with Flinders Petrie and Griffith, and took a leading part, with Montague James, Hogarth, and the present Rector of Lincoln College, in work at Paphos for the Cyprus Exploration Fund Under his management, the British School soon took recognized place among other foreign institutes in Athens, and began to form the long series of explorers, excavators, and teachers at home, which has continued until the present time.

In 1896 the Yates professorship of archæology at University College, London, fell vacant, and gave Gardner a congenial opportunity. Here too he had to begin with the foundations, and secure for his subject a place in the curriculum. His best-known book, a "Handbook of Greek Sculpture", was published in the same year, and at once became the recognized English text-book: later it was supplemented by a more detailed study of "Six Greek Sculptors". In 1897 appeared his "Catalogue of Vases in the Fitzwilliam Museum", and in 1905 he supplemented the "Introduction to Greek Epigraphy" of E. S. Roberts, the Master of his own college, with a volume on the inscriptions of Attica Of more general (and in the best sense popular) quality was his description of "Ancient Athens" (1902), published at a moment of pause after rapid and varied discoveries, when it was possible for one who knew the ground as Gardner did to present the results as a comprehensible whole, in the lucid style and with the fine scholarship which marked all his writing.

In the War of 1914–18, though over military age, Gardner put his intimate knowledge of Greece and the Greek people at the disposal of the Admiralty, and as a lieutenant-commander in the Royal Naval Volunteer Reserve, did valuable service at Salonica; in leisure moments bringing together at the White Tower the numerous antiquities found in the British trenches and within the lines. Of these the most conspicuous was a huge Roman milestone, whose inscription beginning *Kaisari Germanico* caused some mirth among the rank and file.

Returning to London, Gardner found many distractions in university affairs, but continued to publish useful books on ancient life and art in Greece, and to take an active part in the proceedings of the Hellenic Society, of the *Journal* of which he had been editor from 1897, while from 1929 until 1932 he was its president. A characteristic and memorable con-

tribution to classical studies was his series of cruises for students of all ages, undertaken when such facilities were rare and not easy to arrange; they brought him into personal contact with a wide variety of acquaintances, and opened what was then a new aspect of classical study.

J. L. MYRES.

Prof. V. R. Williams

WE learn with deep regret of the death of Prof. Vasili Robertovich Williams, professor of soil studies in the Timiriazev Academy of Agriculture, and well known to soil investigators for his important contributions to agricultural science

Williams was born in Moscow in 1863, the son of an American constructional engineer who had settled in Russia in 1854 and married a Russian lady. He studied at the old Petrovsky Academy of Agriculture and Forestry, to which after a period of postgraduate work in Paris with Pasteur, he returned as lecturer In 1894 the Institute was replaced by the Agricultural Institute of Moscow and he was appointed assistant professor of soils and agriculture. In 1906 he became director of the Institute, and after the Revolution, when it was reorganized as the Timiriazeff Academy of Great Socialist Agriculture, he was again made director though afterwards a political head was chosen in accordance with the policy then prevailing.

From the outset, Williams's soil work centred around the organic constituents: he never lost his interest in these. Only last August he showed me a colourless crystalline organic substance which he had extracted from the soil and to which he attached great importance. Like other Russian soil workers after the Revolution, he did a good deal of soil surveying and he acquired an extensive knowledge of soil utilization and crop production in Russia. On the applied side his most important activity was his keen advocacy of grass leys in the rotation. Russian agriculture was, until recently, mainly based on variants of the old three field system, fallow, winter corn, spring corn Williams knew how greatly the agriculture of Western Europe had improved when a clover or grass and clover crop was inserted between the corn crops, and he strenuously urged that this should be done in Russia. The coming of collectivization gave an opportunity for a change of system, and the need for increasing the animal population after the devastating losses of livestock at first incurred furnished the justification for strenuous efforts to ensure ample production of fodder crops. So Williams used all his great influence in the U.S.S R. to extend the culture of grasses and clovers and showed that, not only would more cattle food be produced, but also the soil fertility would be increased and the danger of erosion lessened

In his later years, Williams devoted much time to the building up of his soil museum, and on each of my recent visits to the Institute he personally demonstrated its chief features: it included a large number of typical profiles with specimens or illustrations of the flora native to each type, and charts showing the most suitable kind of agriculture.

His soil work is described in his book, "Soil Science", first published in 1914 and revised in 1920.

Williams was afflicted with a paralysis which impeded his activities but never damped his enthusiasm. Like others of the older school of Russian scientific workers, he had a good knowledge of a Western language so that conversation and discussion were always easy. In his case the language was English, learned from his father and never forgotten. His work was much appreciated in Russia and he was given the highest awards open to Soviet citizens: the Order of Lenin, a seat in the Supreme Soviet, and membership of the Academy of Sciences; more important still, the deep respect, softened by affection, of many past students now engaged in agricultural organization in Russia One of the pavilions of the great agricultural exhibition at Moscow is adorned with a very large mural painting showing him at work in his department.

E. JOHN RUSSELL.

Mr. G. Eumorfopoulos

WE regret to record the death at the age of seventy-six of Mr. George Eumorfopoulos, which took place on December 19. Eumorfopoulos had long been known as a great collector and skilled connoisseur of objects of Oriental art and more especially of the art of the Chinese.

George Eumorfopoulos was born in Liverpool in 1863. Until 1934 he was a member of the well-known firm of Ralli Bros. His career as a collector began with English and Continental porcelain, but he soon turned to Oriental art, and was one of the first collectors to give special attention to pieces of the earlier Chinese dynasties—Chou, Han, T'ang and Sung. In this field his collection for the beauty, rarity, and historic and archæological value of the specimens it contained, ranked among the greatest in the world. It was thrown open with the greatest liberality to students, fellow-collectors and connoisseurs from any and every part of the world without distinction beyond interest in that field, which Eumorfopoulos by the judicious use of his wealth in the service of his knowledge and his artistic judgment had made peculiarly his own.

Above everything Eumorfopoulos was anxious that so far as was possible others less fortunate than himself should share in the advantages for study that he enjoyed. A type collection of Chinese porcelain was formed by him and presented to the Museum at Athens, and his gifts to other museums were both numerous and valuable; but his greatest sacrifice was unquestionably the sale of his collection as a whole, which through his generosity in accepting a price far below its pecuniary value, became the property of the British nation in 1935. Now, though divided, it forms by far the most important part of the material available for the study and appreciation of the art of the Far East in the national collections.

Eumorfopoulos was also a generous supporter of all forms of archæological investigation, but more especially if it showed likelihood of advancing knowledge of the history of art. As Sir Leonard Woolley

has recalled, he was a generous contributor to the funds for the excavation of Ur; and a visit to the site of the excavation was one of the few occasions on which he travelled in the East. Another which afforded him an even greater delight than that he experienced in Mesopotamia was when in 1935 he travelled in China with R. L. Hobson of the British Museum to help in selecting exhibits for the International Exhibition of Chinese Art held in London in the following winter. The welcome he then received in China was such as befitted his eminence as a collector and expert, and was in a sense the crowning reward of his career.

WE regret to announce the following deaths:

Prof Czeslav Białobrzeski, professor of theoretical physics in the University of Warsaw, recently executed by the German authorities in Poland, aged sixty years.

Sir John Withers, M.P., who has represented the University of Cambridge in Parliament since 1926, a former president of the Alpine Club and member of the Mount Everest Committee, on December 29, aged seventy-six years.

Prof. Hans Ziemann, professor of internal medicine in the University of Berlin, aged seventy-four years

NEWS AND VIEWS

Seventy Years Ago

ON November 4, 1869, the first issue appeared of a new "weekly illustrated journal of science" entitled NATURE. It was under the able and forceful editorship of Sir Norman Lockyer, who secured the support of the leading men of science of the day for the new venture. Turning back in thought to those days, it will be seen that there is a certain parallelism between world affairs of that time and the present international situation. Prussia had defeated Austria and its German allies, and had emerged as a leading European power. Strategic railways had been built to the eastern and western frontiers, and tension between Germany and France increased until in July 1870 war was declared. The campaign was relatively short, but its consequences were momentous and have determined much of the history of the past half-century. It seemed worth while, therefore, to turn back to the early pages of NATURE, to note the reaction of scientific men and affairs to the course of events, and to observe the progress of science as recorded week by week in this journal. Let this be sufficient reason for the column of quotations and notes, taken from the first number of NATURE to appear in 1870, which is printed elsewhere in this issue (p. 41). It is proposed to publish week by week similar extracts from the issues of NATURE of "seventy years ago", in the hope that scientific workers will derive both profit and pleasure from these contemporary accounts of scientific thought and events.

Royal Meteorological Society: Symons Gold Medal

THE decision of the Council of the Royal Meteorological Society to award the Symons Gold Medal for 1940 to Dr. J. Bjerknes will be very popular among British meteorologists, to whom he has become well known during his frequent visits to this country. In 1932 the Medal was awarded to his father, Prof. V. Bjerknes, and it is fitting that the son, who shared the work, should also share the honours. Dr. J. Bjerknes is well known for his numerous and penetrating memoirs on the structure of barometric depressions and on the mechanism of the atmospheric circulation Among his earlier papers we may mention "On the Structure of Moving Cyclones" (1919), and (with H Solberg) "Meteorological Conditions for the Formation of Rain" (1921), and "The Life Cycle of Cyclones and the Polar Front Theory of Atmospheric Circulation" (1922) in which he laid down the principle of 'cyclone families' and emphasized the role taken by depressions as an integral part of the exchange of air between high and low latitudes

Later, while temporarily on the staff of the British Meteorological Office, Dr. Bjerknes compiled "Practical Examples of Polar-Front Analysis over the British Isles in 1925–6", published as Geophysical Memoir No 50, and he has since analysed in great detail, on the bases of both surface and upper air observations, a number of depressions presenting special features In 1933 the accumulated research of the Norwegian school of meteorologists into the dynamics of the atmosphere was published in book form under the title "Physikalische Hydrodynamik" by V. and J. Bjerknes, H Solberg and T. Bergeron Dr. Bjerknes is still young, and we look forward to further important research in future from these brilliant Norwegians.

University of Oxford: Chair of Forestry

MR H. G. CHAMPION has recently been appointed to fill the chair of forestry at Oxford in succession to the late Prof. R. S. Troup. Mr. Champion graduated at Oxford with first-class honours in chemistry and botany. He went out to India in the Forest Service in 1915 and was posted to the United Provinces. After successful work in divisional and working plans posts he was selected for appointment as sylviculturist at the Forestry Institute at Dehra Dun In this post he carried out some notable work. Perhaps Mr. Champion's most important contributions to sylvicultural research in India and Burma were a "Sylvicultural Research Manual for India", in two volumes—"The Experimental Manual" and "The Statistical Code"—and a "Preliminary Survey of the Forest Types in India and Burma".

The opening paragraph of the "Research Manual" is testimony to Mr. Champion's methods—"Research work ought never to be hampered by compulsory adherence to any prescribed methods of investigation or of recording. This does not, however, prevent the research worker from receiving considerable aid from the results of his own experience and that of others". This dictum he illustrated in his "Problem of the Pure Teak Plantation", which included valuable notes supplied by the Forest Research Institute of the Dutch East Indies Other monographs published were notes on *Pinus longifolia*; contributions towards a knowledge of twisted fibre in trees; the importance of the origin of seed used in forestry; rejuvenation and management of sal (*Shorea robusta*); and a "Manual of Indian Sylviculture" (with Sir Gerald Trevor). In addition to visiting all parts of India and Burma as sylviculturist, Mr Champion was asked by the Government to advise on the management of the Ceylon forests. He visited North America, Japan and Malaya to study local forest soil conservation problems, and saw something of the Kenya forests on his way home on leave in 1939.

Prof. W. P. Jorissen

THE Netherlands Chemical Society announced on December 23 that Prof. W. P. Jorissen is retiring from the editorship of the *Chemisch Weekblad* after serving that journal for thirty years. Although Holland is a small country, it has for many centuries been to the fore in the advancement of science, and Prof. Jorissen, who celebrated his seventieth birthday on November 11, 1939, will rank as one of the country's most distinguished chemists. Since his first paper in 1894 dealing with the oxidation of phosphorus, he and his collaborators have contributed many papers from the laboratory for physical chemistry at the University of Leyden. The most important of these deal with his detailed study of the regions of reactions among gases, and even among solids, and with the physical chemistry of explosions (notably the limits). In addition to his academic and research activities at Leyden, Prof. Jorissen, who is an excellent linguist, was editor-in-chief of the *Recueil des travaux chimiques des Pays-Bas* as well as of the *Chemisch Weekblad*. This brought him into lasting contact with the many British chemists who have had occasion to contribute to this Netherlands monthly journal, which publishes communications in French, German and English. We join with his Netherlands colleagues in wishing Prof. Jorissen a long and happy retirement.

Parliamentary and Scientific Committee: New Chairman

AT the last general meeting of the Parliamentary and Scientific Committee at the House of Commons, Captain L. F. Plugge, M.P., was unanimously elected chairman. Captain Plugge is a science graduate of the University of London and also of the University of Brussels. During the War of 1914–18, when serving with the Royal Naval Air Service, he was the Admiralty representative at the National Physical Laboratory at Teddington. He also served on the directorate of Aeronautical Research at the Air Ministry under Sir Robert Brooke-Popham, when he evolved in collaboration with Dr. Thurston the design of the first military aeroplane constructed entirely in metal to be built in Great Britain He has been a fellow of the Royal Aeronautical Society since 1923, and was responsible for the Society's glossary of aeronautical terms (French translation). His work on wireless, which has covered the last fifteen years, is well known, and he is an authority on matters relating to broadcasting.

The University of Cracow

EXPRESSIONS of sympathy have been received by the Polish Ambassador in Great Britain from universities in Great Britain, the Association of University Teachers and the Universities Bureau of the British Empire in reply to a statement concerning German activities in connexion with the University of Cracow (*The Times*, Dec. 22). It appears that the members of the teaching staff of the University were invited to attend a conference at which the German attitude toward Polish men of learning was to be explained The tone of the address offended the audience, who walked out, to find lorries waiting outside, in which they were removed and sent eventually to a concentration camp in Germany.

It is stated that 160 members of the University are involved, including Prof. Kazimierz Kostanecki, a former president of the Polish Academy of Sciences, and Adam Krzyzanowski, a distinguished economist, who has since died. A message from the University of Leeds contains the following passage: "The members of the Senate of the University of Leeds . . . desire to place on record their strong condemnation of an action which can have no military justification and must be regarded as part of a deliberate and wanton attempt to destroy the culture and learning of the Polish peoples" We are sure that readers of NATURE will be in hearty support of this view.

The University of Birmingham

THE University of Birmingham has settled down to war conditions more smoothly than was anticipated, thanks largely to the recruiting policy of the Government whereby some of the deplorable errors of the War of 1914–18 in the waste of ability of university students have been avoided. The number of students in some departments has actually increased, and in the department of medicine in particular the number of full-time freshmen has reached a total of forty-four more than that of last year. The Nuffield Physics Extension Block is nearly ready for occupation, but the exigencies of war-time have unfortunately interrupted the building of Prof. Oliphant's large cyclotron, which is to be the chief feature of the new block.

The new gymnasium of the University also is nearly complete, and it is hoped that it will be used in the near future for physical training. The plans for extension of the Students' Union have had

to be dropped for the present. Extra-mural work under the Joint Committee of the University and the Workers' Educational Association has made progress and the number of classes and students has increased. Prof. W. K. Hancock has been given leave of absence to visit West Africa for a study of West African problems in continuance of his "Survey of British Commonwealth Affairs". Dr. O. Frisch of Copenhagen has been appointed a temporary member of the staff of the Physics Department.

Social Services for Youth

THE Board of Education has directed attention to a serious deficiency in our social services in a circular recently issued to the local education authorities for higher education in England and Wales, and a similar circular has been issued by the Secretary of State for Scotland to the education authorities in Scotland. These authorities are asked to take steps to set up local youth committees in their areas, and voluntary organizations and education authorities are called upon to combine in making real provision for the social and physical development of young persons between the ages of fourteen and twenty who have ceased full-time attendance at school. This neglected and elusive problem has been accentuated by war conditions—the black-out, the strain and disorganization of family life—and the Board of Education has now assumed a direct responsibility for juvenile welfare. The National Youth Committee has been appointed to advise them and a special branch of the Board of Education office has been organized to deal with grants and other administrative duties.

The new committees will place youth work on an equal basis with the rest of education Sometimes they will be sub-committees of local authorities, others may represent all local interests including the local authority. Their task will be to work out an ordered policy, meeting both the immediate needs and indicating the lines of advance under more favourable conditions. Local education authorities are expected to see that the Committee is properly staffed and equipped with office accommodation, and they can assist financially by making grants towards the rent of buildings, salaries of full-time leaders, upkeep and maintenance of premises, including provision of equipment and instructors The appointment of the National Youth Committee has been welcomed by the King in a message to the Prime Minister, in which His Majesty appeals to the public for volunteers to undertake the tasks of leadership and organization which these plans envisage, and an announcement asking for volunteers has already been made by the President of the Board of Education and the Secretary of State for Scotland at the request of the National Youth Committee.

American Psychologists in War-time

AMERICA believes in being forearmed. Already the American Association for Applied Psychology has devised a plan to mobilize psychologists to aid the Government in time of emergency as they did in 1918 (Science Service, Washington, D.C.). The chief problems to be considered are connected with the selecting and classifying of men according to their abilities, the selecting of promising recruits for military flying, treating those who break down under the strain of war and discipline, and keeping up the morale of armed forces and those at home. The human element and human 'nerves' are much more important now than in the War of 1914–18, although even then a considerable proportion of war casualties were 'nervous' cases.

At the meeting which discussed the matter there were representatives of the Army and Navy, the Public Health Service, and the Department of Justice. The armed services have already arranged to avoid in any future war the heavy psychological casualties of the last war The first step has been to provide for the careful psychiatric examination of all new recruits, with an observation period in which any border-line cases might be weeded out or assigned to jobs where personality difficulties will be at a minimum. They are also discussing whether, by means parallel to those used by enemy agents to foment discord, psychologists could be used to promote good feeling and smooth out grievances.

Aquaria Societies' Difficulties

THE wartime difficulties of aquaria societies, especially those which maintain public aquaria, have not proved so disastrous as at first expected. The Scottish Aquarium Society, at a recent meeting, decided to produce a modified edition of its journal *Scottish Aquarium Herald*, as Mr R. Kerr, the original editor, is serving in H M Navy Brighton Aquarium recently acquired an attractive exhibit of 120 silver whiting (*Gadus merlangus*), as well as congers, anglers, spider crabs, ocean sunfish and an owl fish. The Carnegie Aquarium at Edinburgh is also managing to keep a full stock of exhibits, including herring Manchester Zoo Aquarium has 41 specimens of *Neon tetra* on view in the tropical section, as well as a large electric eel. Dudley (Worcestershire) Zoo Aquarium recently received some claw-footed toads.

On the Continent, Paris Zoo Aquarium has distributed its fish to the Prince of Monaco's Aquarium at Monte Carlo and to private individuals, and its reptiles to Marseilles Zoo. The aquarium at Berlin Zoo has been broken up and closed and the reptiles destroyed. Hamburg Zoo has disposed of all its collection. Belle Vue (Manchester) Aquarium and Vivarium Society has decided to levy half the normal subscription and review the position again in six months' time.

Archæological Discoveries of 1939 in Ireland

ARCHÆOLOGICAL excavations in the vicinity of Lough Gur, Co. Limerick, in the season 1939, it is claimed in a report in *The Times* of January 2, have obtained results of outstanding significance for Irish archæology. This area has now been under investigation for four consecutive seasons, thanks to the Government's scheme for the relief of unemployment;

and several sites have been examined, including three stone circles, a megalithic tomb, and a series of dwelling sites. The excavations have been carried out under the direction of Prof. Seán P O'Riordain of the University of Cork. The principal site excavated in 1939 was a large and exceedingly well-preserved stone circle on the western side of the lake, near the Bruff-Limerick road. Not only is this the best known prehistoric monument of the Lough Gur, but it is also said to be the finest stone circle in Ireland It is built of large stones backed up by a huge bank of earth, and encloses a level, open internal space 155 ft in diameter.

Here important finds of pottery were made, of which some afford evidence for a new chapter in Irish archæology A reconstructed vessel proved to be a 'beaker', the first of its kind to be found in Ireland It belongs to the class of ceramic characteristic of the 'Beaker Folk', who reached Britain in the late neolithic or Early Bronze ages, but, it has been thought hitherto, did not reach Ireland. A further discovery of considerable interest is that of neolithic pottery of types found only sporadically in Ireland, except in the north-east. On the evidence of the finds, the circle is dated at approximately 1700 B.C., and its ritual purpose, that of a prehistoric temple, is regarded as definitely determined. In a group of neolithic houses on the peninsula of Knockadoon in Lough Gur, one, exceptionally well-constructed, is said to be the earliest house yet found in Ireland. It is 32 ft. long by 18 ft. wide. The lower part of the walls is of stone, the superstructure of wood and thatch—a type well known from various periods in northern Europe

Landscape Meteorology

MR L. C. W BONACINA's paper entitled "Landscape Meteorology and its Reflection in Art and Literature" (*Quart. J. Roy. Meteor Soc.*, **65**, No 282; October 1939) is a detailed study of the scenic aspect of clouds and weather, and an example of that co-operation between science and art which is one of the most interesting developments of culture during recent years. We welcome particularly the author's dictum that it is a mistake for the man of science to regard scenic values as altogether outside his province. It is equally to the point that the landscape artist will find additional enjoyment, and possibly also increased efficiency, if he studies the physics of meteorological effects. The later part of the paper is mainly devoted to descriptions of local and seasonal phenomena. One outstanding example is that of the night sky as seen from the high plateau of Bolivia, where the general aspect of the constellations is that of coloured stars.

Valuable as is this elaborate paper, the reader cannot help feeling how great is the difficulty of bringing the artistic and scientific aspects of a subject into one essay. The perceptive and reflective moods are alternate, and the literary technique for their simultaneous treatment has not been fully mastered. Indeed, we do not yet know if it can be mastered. If so, it will be by Ruskin re-incarnate in the world of to-day, with the same faculties of sight and expression but imbued with the culture of the present time.

Malnutrition in South Africa

AN informative survey of the state of nutrition of the peoples of South Africa is given by Ellen Radloff and T. W B Osborn in a pamphlet with the above title (Johannesburg. The Witwatersrand University Press, 1939. 2s.). South Africa has been spoken of as the most prosperous country in the world, which is a true statement for a minority of the European section But South Africa is also a country of poor whites and poorer blacks, which is true for several millions of non-Europeans and several hundred thousands of Europeans The principal dietary essentials for proper nutrition are discussed, with descriptions of the conditions that result when these are deficient Tables are given of the vitamin content of common foodstuffs and of typical South African diets

The basic ration scale recommended for adult Europeans at the Health Department's institutions appears to be ample and adequate, and is in striking contrast to the daily diet scale for adult native paupers in Cape Province, which consists of 1 oz of fat (not butter) and 24 oz of mealies. Remedies are suggested for the malnutrition that exists, which include improvement of the economic condition of the people, educating them to buy meat, milk, fruit and vegetables, and in rural communities providing more land for them to buy and improving their grade of cattle A direct pharmacological approach to the question is also suggested by providing rations of essential salts and vitamins

Underground—and the City of the Future

IN the *Beama* journal of November reference is made to Le Corbusier's city of the future consisting of dwellings, offices, and factories contained in huge blocks separated by gardens. One of the main features of this modern city is the large part of its activity which takes place underground. Power stations, garages, warehouses and other public service buildings, as well as traffic routes for vehicles and pedestrians, would be constructed in this way. Already there exists a plan for the diversion of a large part of the Paris traffic, the underground routes for which were examined by the Minister of Public Works some years ago. *Électricité* published a report on this subject by M. Roger d'Arboville, professor of applied electricity in the well-known École spéciale d'Architecture, on the lighting of underground traffic and pedestrian routes. He reviews the practice exemplified in some of the short subways in Paris, in the long road tunnel projected for 1941 under the Meuse, the mile-long roadway under the Escaut at Antwerp and various railway tunnels in France and England.

M. d'Arboville discusses the question of the lighting of underground road tunnels both in actual road tunnels and in many tunnels which are projected. The ever-increasing density and speed of

road traffic make this question of great importance, especially at the entrances to the tunnels. The light conditions at these places must be very carefully graded or else the speed of all transport entering the tunnel must be heavily stepped down. The latter course is objectionable as it interferes with the normal flow over a wide area. He suggests that photo-electric cells might be used to maintain the lighting more constant and so overcome the changing variations of natural light The photo-cells should be directed towards the ground, since otherwise the effect of sunlight variations is too strong.

Dismantling an Old Colliery

WE learn from an article in *Roads and Road Construction* of December 1 that the famous Cymmer Colliery at Porth, Glam., from which coal has been raised for more than a hundred years, has recently ceased work. The immense quantity of plant which it contains is to be dismantled and made available for use either in the coal industry or in similar industries engaged on contracts of national importance. In the history of this colliery, which once employed more than three thousand men and produced more than three thousand tons of coal a day, an interesting story is told of how about fifty years ago, whilst boring in the shaft for piping supports, the men struck what is called a 'gas blower', which is a sort of pocket of free gas. In these days men were permitted to take naked lights down in the cage with them so that they could heat their tea, and one of these lights ignited the natural gas As it was dangerous to allow such gas to escape into the shaft, a two-inch pipe was installed to conduct it to the surface. Here it has been burning for fifty years without being extinguished. Measurements show that approximately 650 cub. ft per hour was being emitted at the 'blow'. The gas is chiefly methane, and arrangements have now been made to 'bottle' it in steel cylinders at about 800 lb. per sq. in. pressure for scientific and industrial use.

Messrs. George Cohen of London and Swansea are at the present time running a 5,000 cub. ft vertical engine-driven compressor now in the mine to supply air to the haulages for removing the underground plant and machinery, of which there is no less than 4,000 tons, including about 1,200 tons of pit rails. Compressed air was also supplied below for working coal-cutters, jigger conveyors, belt conveyors, and turbine fans Electric light, both for underground and surface, is supplied by steam-driven generating sets. In 1933 a modern dry coal cleaning plant of 75 tons per hour capacity was installed at a cost of about £20,000 by the Birtley Iron Co The roads to the pit are in excellent condition, being supported by about 1,700 tons of steel arches, of which Messrs. Cohen expect to recover about 500 tons

Hydro-Electric Development in India

RECENT reports from India, referred to in *Beama* of November, state that a very large irrigation scheme which will include the generation of large quantities of electric power between the Punjab and the State of Bilaspur is under construction. The volume of water that will be impounded is three times as large as that of the Aswan dam across the Nile A further scheme for the development of water power utilizes the high run-off of the monsoon rains from the High Range Hills to the plain at Travancore in southern India. Power is obtained from the Munnar River as it descends in a series of cascades from the hills. The monsoon waters are impounded in storage reservoirs built on natural sites. The power station is built on the banks of the river, with the tail-race planned to discharge into it. Above stream, the river water is decanted by a weir, then passes through a channel to the tunnel and forebay. From there it is carried in a 10,000 ft long tunnel — an open channel was impracticable owing to the crumbling nature of the surface rock —to the surge tower Two parallel pipe-lines connect with the power house, each supplying water to a 6,000 brake horse-power turbine

Weather by Telephone in New York

ACCORDING to the *Bell Laboratories Record* of November, the New York Telephone Co. inaugurated a new service last April. It is now possible in the Metropolitan area to dial 'weather', and hear the latest weather prediction, including the anticipated temperature, winds, and rain or snow conditions The bulletins are based on direct teletype reports from the United States Weather Bureau , at present these reports are changed hourly between seven in the morning and eleven at night. When important changes occur, special bulletins may also be given. All the equipment used for this service is installed in the West Fiftieth Street Central Office building, and weather announcing trunk lines are run to all the central offices in Manhattan, while other parts of the metropolitan area reach the announcing bureau through subcentres or tandem offices. In the time-announcing system a special operator makes each announcement herself. In the weather system use is made of a recorder using magnetic tape. It is well suited for this service as it is necessary to change the recorded message frequently and permanent preservation of the record is of no importance.

The record is made in the usual way by producing, in a moving steel tape, a magnetic pattern corresponding to the voice current coming from the microphone circuit. This pattern remains in the tape and can be 'picked up' electrically many thousands of times before being erased. This is done by saturating the tape with a strong magnetic field. The entire process of erasing, recording a new message and reproducing is controlled by a few keys in the operating turret. No experience or technique is required to obtain exact reproduction of the announcement, and since the steel tape can be used again and again indefinitely, there is no continuing expense for record material and no processing cost involved Three of these machines are used. The tape machine employs slightly more than 40 ft. of tape wound on three brass drums. The two ends of the tape are electrically welded so that it forms a single tape loop.

Demography of Canada

ACCORDING to the report recently made to the International Office of Public Health (*Bull. Off. internat. d'hyg. publ.*, 31, 1678; 1939) by Dr. H. B. Jeffs, the delegate for Canada, the population of Canada, exclusive of Yukon and the North Western Territories, amounted to about 11,106,000 on June 1, 1937. The marriage-rate for 1937 was 7·9 per 1,000 inhabitants. The highest percentage of marriages was registered in Manitoba (8·5) and the lowest in Saskatchewan (6·2) The birth-rate was 19·8 per 1,000 inhabitants as compared with 20·0 in 1936. The total number of live births was 219,988 in 1937, as compared with 220,371 in the previous year. The highest birth-rate was in the province of Quebec, where 75,635 births were registered or a rate of 24·1 per thousand inhabitants. In 1937, 113,694 deaths were registered in Canada or a mortality of 10·2 per 1,000 inhabitants, as compared with 9·7 in 1936. The total number of deaths of children under one year of age was 16,675 or a mortality of 76 per 1,000 live births as compared with 66 in 1936. The maternal mortality was 1,067 in 1937 or a mortality of 4·9 per 1,000 live births, as compared with 1,233 deaths or a rate of 5·6 in 1936. The highest maternal mortality was in Prince Edward Island (5 8 per 1,000 live births) and the lowest in Nova Scotia (2·7 per 1,000 live births)

A New Biological Journal

UNDER the title of *Lloydia* the Lloyd Library of Natural History, Cincinnati, Ohio, has commenced the publication of a new quarterly journal of which the first number appeared as Vol 1, Nos. 1–4, 1938; the date of publication is given as January 7, 1939, but a copy has only just reached NATURE The subscription rate is three dollars per annum. The editor is Theodor Just From the numbers already published, the main field of the new journal would seem to be systematic, but papers dealing mainly with structure have been published and many of the communications have been freely illustrated with both drawings and photographs. Manuscript contributions are welcomed, as also exchanges with other institutions Communications should be addressed to the Librarian, Lloyd Library, 309 W Court Street, Cincinnati, Ohio.

Bibliography of Seismology

THE *Bibliography of Seismology*, 13, No. 2, published by the Dominion Observatory at Ottawa, has just been received. It contains 124 items over the period April, May, June 1939, and has been compiled with the assistance of collaborators in Canada, United States, New Zealand, Italy, Germany, Norway, Japan, U.S.S.R., France, Holland and England. As in the preceding number, in addition to works on pure seismology, there is again a considerable number of works listed on applied seismology, chiefly concerned with geophysical prospecting. A list of patents concerned with this latter contains eight items, five being United States patents, one Canadian, and two U.S.S.R. It is pleasing to see a considerable number of papers listed from the Seismological Institute, Academy of Sciences, U.S.S.R., though it would add to the value of these Russian works if the authors supplied translations or abstracts in French, German or English. Unfortunately, again South America is not represented.

Earthquake in Central America

AN earthquake of considerable intensity was experienced on the Pacific coast of central America on December 5 just after 8.30 G.M.T., though no damage has been reported. The shock was recorded on practically all the seismographs in America; at De Bilt (Holland), where the preliminary waves arrived just after 8.42; and at Kew, where a full complement of waves including P_cP, SKS and SSS were readily discernible. The maximum ground displacement at Kew was 0·043 mm. From readings of seismograms at adjacent stations, the epicentre has been determined by the United States Coast and Geodetic Survey to have been in the Pacific Ocean some twenty miles due east of Rio Suchiate (Guatemala).

Announcements

THE U.S.S.R. Academy of Sciences has marked the sixtieth birthday of M. Joseph Stalin by electing him an honorary member of the Academy, nominally in recognition of his contributions to the development of the social theories of Marx and Lenin. It should be noted that even the ordinary membership of the Academy is restricted to a limited number of men of science of outstanding repute, while there are very few honorary members, all of them hitherto being scientific men of international fame.

PROF. FRITZ LEJEUNE, of Cologne, has been appointed professor of the history of medicine and director of the Institute of the History of Medicine at Vienna.

THE Italian Minister of the Interior has offered a prize of 30,000 lire for the discovery of chemical or biological substances to take the place of insulin.

THE League of Nations Health Committee has arranged to set up a sub-committee which may be summoned in an emergency to deal with epidemics of infectious diseases arising out of the War.

THE Ministry of Health has published a memorandum on typhoid fever for the use of local authorities and medical officers of health (Memo. 225/Med. H.M. Stationery Office. 2*d*. net). The memorandum deals with typhoid and paratyphoid fevers, their history, diagnosis, prevention and control, and it contains an appendix on laboratory methods of diagnosis.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 32. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A Factor influencing Nitrogen Excretion from Leguminous Root Nodules

THE excretion of nitrogen compounds from leguminous root nodules which has been demonstrated in this laboratory with a sterile culture system and, from the practical point of view, investigated with ordinary pot cultures, has not been shown in the pot cultures of all investigators[1,2]. With a sterile culture system Wilson has accomplished the excretion almost regularly[3]

It is difficult for us to explain the negative results appearing in the literature since, during 1928–38, we have regularly obtained excretion, and often a very powerful one, in hundreds of experiments also with pot cultures. In 1938 and 1939, however, excretion occurred only in a part of the experiments. Of parallel cultures under the same conditions, some showed powerful excretion while little or no excretion occurred in others. Light intensity could therefore not be the cause of conflicting results, as the plants were growing under identical conditions. There was also no difference in the quality of the quartz sand used in them.

In trying to discover the cause of these variations we finally paid attention to the quality of the containers. We have always used unglazed pots of burned clay. When we examined the pots used in the summers of 1938 and 1939 we noted great variations in their porosity. The pots in which oats grew fairly well in association with inoculated peas proved to be more porous than those where the growth of the oats was poor. The porosity of the pots was measured by allowing them to soak in water and determining the time which was required to make the inside of the pot moist. The accompanying table illustrates some of our results

Unglazed burned clay pots, diam. 9 in , 7 75 kgm quartz sand, 4 peas (inoculated with bacterial strain *H X*) and 6 oats (Guldregn II) in each pot. Control: 6 oats alone N-free nutrient solution. Period of growth 20 July–25 Sept 1939. 3 parallel experiments.

Variety of pea	N in peas, mgm.	N in oats, mgm.	Excreted N taken up by oat, mgm.	Soaking time of the pot, min.
Adoptive	172·2	69·6	55 2	38
	100·8	40 9	26 1	81
	167·6	24 1	9 8	105
Concordia	204·3	48 2	33·4	20
	430·9	13 4	− 1·4	60
	247·6	32·5	17·7	25
Marmor. Gloriö	167·8	74·2	59·4	45
	546 1	17·9	3 1	165
	616 9	13 4	− 1 4	160
Control		15·4 } 14·8		
		14·8		
		14·3		

Our results show that the growth of oats in associated culture with pea depends evidently on the porosity of the culture pot, and thus on the aeration of the media As the experimental conditions sand and nutrient solution—have been identical in all experiments, only the difference in the quality of the pots can explain the decided variations in the excretion of the parallel cultures. The experimental data also illustrate the fact noted earlier that when the excretion is high the growth of the pea is often, though not always, impaired.

When the excretion of nitrogen from the leguminous root nodules is investigated in associated cultures with ordinary pot cultures, containers should be clay pots, which are very porous. Large pots generally give better results than small ones

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Nov 30

[1] Bond, NATURE, 140, 683 (1937)
[2] Wilson, NATURE, 140, 154 (1937).
[3] Wilson, *J Agric Sci*, 27, 307 (1938)

Effects of Concentrated Aqueous and certain Non-aqueous Solutions of Alkali upon Wool

CHEMISTS are well aware that wool is readily attacked by alkaline reagents. These disrupt the disulphide groups of the cystine contained in the polypeptide chains, thus weakening the fibre structure The woollen manufacturer also recognizes that wool is susceptible to attack by alkali, as the term 'alkali damage' indicates. This damage frequently results from inefficient scouring which afterwards causes the wool to dye unevenly.

The surprising fact that the fibre is not seriously damaged by cold, concentrated, aqueous solutions of sodium hydroxide was investigated by Buntrock[1], Matthews[2], and Speakman[3]. The two earlier workers showed that yarns, treated with 52 per cent aqueous sodium hydroxide solutions, became stronger. Matthews reported that the sulphur content was greatly lowered by the treatment, that the surface

scales of the individual fibres fused together, that the ability of the wool to felt was not reduced, and that its affinity for acid dyes was increased. Speakman showed that the strength of individual fibres was unaffected by this treatment. He suggested that the increased strength of yarns was due to the fusing together of different fibres under the influence of weakly alkaline solutions formed during the processes involved in the removal of the alkali from the wool. Some of these matters have been reinvestigated by us, and particular attention has been given to the removal of the alkali in such a way that risk of damage to the fibres in this process was minimized. A summary of our results follows.

(1) The sulphur and nitrogen contents of merino wools are very little altered by immersion in 52 per cent sodium hydroxide for periods up to 30 minutes at room temperatures

(2) No major changes in the surface structure of the fibre result from such a treatment for 5–10 minutes. Microscopic examination shows little or no difference between treated and untreated fibres

(3) Wool treated with concentrated solutions of sodium hydroxide absorbs acid dyes *evenly*. Such wools have a greater affinity for acid dyes than similar untreated wools.

(4) A woven woollen fabric treated with 52 per cent sodium hydroxide shows less tendency to shrink on washing than a normal fabric.

These studies have been extended to the treatment of wool with alkalis dissolved in certain organic solvents. By using much weaker alcoholic solutions of sodium (or potassium) hydroxide, similar results to those obtained with concentrated aqueous solutions can be obtained with less risk of damage to the wool The reduced tendency of treated wools to shrink, moreover, is much more marked, especially when knitted fabrics are used. This has been found to depend on :

(a) The nature of the alkali used Potassium hydroxide gives slightly better and more even results than sodium hydroxide.

(b) The nature of the solvent. Solutions of alkali in dry methyl alcohol give less satisfactory results than similar solutions in alcohols of higher molecular weight

(c) The percentage of water present in the solvent. The results are obtained slowly with dry reagents and quickly if 10 per cent or more of water is present. Damage to the fibre is more likely at these higher concentrations, and the optimum water content for speed of reaction, ease of control and minimum risk of damage is about 5 per cent.

The time of reaction depends on the concentration of the alkali used ; thus we have found that with more dilute solutions longer immersion periods are required to give satisfactory results

The limits that have been found with 7 per cent potassium hydroxide solutions are 1–30 minutes, depending on the water content of the alcohol used, and the treatment period may be extended to 16 hours with similar solutions of 0·05 per cent concentration. The rate of action increases with temperature.

Risk of damage to fibres after they have been treated with alcoholic solutions of alkali is eliminated by neutralizing excess alkali in a bath of 5 per cent, by volume, concentrated commercial sulphuric acid in alcohol. If hydrogen sulphide is evolved during the treatment it indicates that the process has been carried out incorrectly, and the wool will probably be damaged.

As regards strength and ability to stretch, treated fibres are not different from untreated. Their surface, however, is rougher than that of untreated fibres These physical tests have been made by our colleague, Mr E. H Mercer, who has also noted that the more tightly twisted yarns of treated fibres are stronger than similar yarns of normal wool.

This method of treating wool promises to be of importance from both the commercial and the purely scientific points of view. Commercially, a treatment of wool for less than two minutes may give a product which is substantially non-felting, which absorbs dyes more readily, which can be made into stronger yarns, which will wear more satisfactorily than normal wool, and which shows less tendency to develop a fluffy surface during wear Scientifically, the reagents may prove useful in further study of (a) the capacity of wool to combine with alkali ; (b) the cause of felting and shrinkage resulting from this ; and (c) the molecular structure of wool.

A full account of our work will be published shortly as a bulletin of the Council for Scientific and Industrial Research. The work has been facilitated by financial assistance granted by the Australian Wool Board.

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[1] Buntrock, *Farber Z*., **9**, 169 (1898)
[2] Matthews, *J Soc Chem Ind*., **21**, 185 (1902)
[3] Speakman, *J Soc Chem Ind*., **118**, 321 (1929).

Amine Oxidase and Benzedrine

EXPERIMENTS which we have carried out during recent years seem to be of general interest in connexion with the observation reported by Mann and Quastel[1] on the effect of benzedrine (β-phenyl*iso*propylamine) on the metabolism of the central nervous system. First, it now seems possible to relate the action of the drug to an *in vitro* effect on one of the enzymic systems in the body ; secondly, we can in this instance relate the action of the drug to its chemical structure. The effect on metabolism finds its explanation in the inhibitor action of β-phenyl*iso*propylamine and its derivatives on amine oxidase. This effect was first described for ephedrine[2], but it was shown soon afterwards that ephedrine shared it with all other derivatives of β-phenyl*iso*propylamine that were examined[3]. The general rule emerged from these experiments that substances of the constitution

$$\mathrm{R{-}\overset{|}{\underset{|}{C}}{-}CH.NH_2{-}CH_3}$$

act as inhibitors of the enzyme. The characteristic difference between substrates and inhibitors of amine oxidase is that the latter contain the amino group not attached to a terminal carbon atom of a chain. It is known that the awakening effect of these drugs is also bound up with this characteristic structure, and that it is absent from those substances in which the amino group is attached to a terminal C atom of a chain[4,5]

Partly through the kindness of Dr. G A. Alles, of Los Angeles, I have recently had the opportunity of examining a number of different amines of this group and have shown that a further subdivision of the β-phenyl*iso*propylamine group of inhibitors is possible. Substances of the structure $R—CH_2—CH.NH_2—CH_3$, for example, veritol and benzedrine, are much stronger inhibitors of amine oxidase than those of the structure $R—CHOH—CH.NH_2—CH_3$, for example, ephedrine; a comparison with the awakening properties of these substances in the living animal shows that there is again agreement between *in vitro* effect and pharmacological action[4]*.

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Dec. 8.

* These experiments were carried out with a grant from the Ella Sachs Plotz Foundation

[1] Mann and Quastel, NATURE, 144, 943 (1939)
[2] Blaschko, Richter and Schlossmann, *Biochem J*, 31, 2187 (1937)
[3] Blaschko, *J Physiol.*, 93, 7P (1938).
[4] Jacobsen, Christensen, Eriksen and Hald, *Skand Arch Physiol*, 79, 258 (1938)
[5] Alles, *Amer. J Physiol.*, 126, 420 (1939).

Electrophoresis of Animal Viruses and their Neutralizing Antibodies in Low Concentrations

A PERUSAL of the literature dealing with the physico-chemical properties of animal viruses and their neutralizing antibodies reveals the fact that very little attention has been given to the mobility in an electric field of these important substances.

The main investigations on the electrophoresis of viruses and their neutralizing antibodies have been to determine the sign of the charge and the direction of mobility[1,2,3], the separation of virus from virus-antibody mixtures[4,5], and the recovery of virus from the brains and spleens of animals recovered from virus diseases[5].

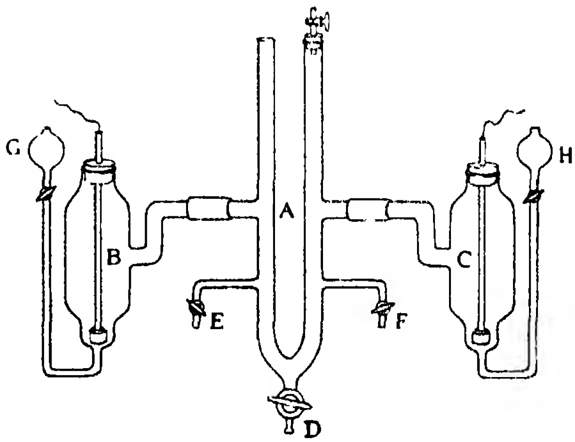
In none of the above-mentioned investigations has any attempt been made to determine the rate of migration of the viruses or their neutralizing antibodies, as the apparatus employed was highly unsuitable for that purpose. In order to measure the migration of viruses and their neutralizing antibodies an apparatus was constructed which has been applied with success to such measurements.

With the aid of the accompanying diagram the essential parts of the apparatus can be explained. *B* and *C* are two electrode vessels connected up to the U-tube *A* in the way illustrated. Two reversible silver–silver-chloride electrodes in saturated potassium chloride solution serve as anode and cathode. The electrode vessels and U-tube are filled with buffer against which the substance has previously been dialysed. By means of the two vessels *G* and *H* saturated potassium chloride solution is let into the electrode vessels to cover the electrodes. The virus or antibody in serum buffer mixture is let through the tap *D* to form a boundary under the buffer solution in *A*. The boundaries are brought up to levels above the two taps *E* and *F*. A position is marked off 2 cm. above the boundaries between the buffer and serum buffer mixture, and the electric current switched on. At the position 2 cm. from the original boundary small samples of fluid (0·1 c.c.) are carefully pipetted off with a fine pipette after suitable time intervals and tested by means of biological methods for virus or antibodies. The limb of the U-tube in which the samples are not taken is kept closed by means of a stopcock. The samples remain negative until the virus or antibodies reach the pipette.

The mobility of the substance investigated is given by the equation[6]

$$\mu = D x O/tA,$$

where D is the distance traversed by the substance (here 2 cm); x is the conductivity of the solution; O is the cross-section of the U-tube at the point where the samples are taken; t is the time required for the substance to traverse the distance D; A is the strength of the electric current.



By plotting the mobilities at various hydrogen ion concentrations against the hydrogen ion concentrations of the buffer, the iso-electric point can be determined by extrapolation or interpolation[6]. The experiments are conducted in a room at constant temperature and a small current is employed, generally 1 milliampere, to minimize heating effects which might cause convection currents. It would be more preferable to conduct the experiments in a water thermostat. The apparatus employed is a modification of the Tiselius moving boundary method[6,7], but it is less complicated and less expensive, and with suitable optical arrangements and proper thermostatic control it can be used for similar purposes, for example, separation of the components in protein mixtures.

An extensive report on the electrophoresis of viruses and their neutralizing antibodies will be published in the *Onderstepoort Journal*.

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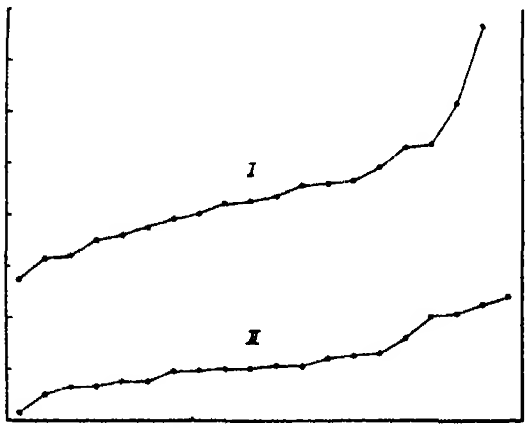
Relation between Corpus allatum and Ovaries in Adult Flies (Muscidæ)

THE adult Muscids examined by me (Musca, Calliphora and Lucilia) possess an unpaired median corpus allatum which is situated dorsal to the œsophagus in the region connecting the neck with the prothorax. Just beneath the corpus allatum lies the aorta, beneath this comes a sympathetic ganglion (ganglion hypocerebrale), and below this lies the œsophagus. An examination of newly hatched unfed females of *Musca domestica* showed the presence of a small rather flat corpus allatum, whereas the same organ of mature females was considerably larger, which was also the case in Calliphora and Lucilia. Thus it seems reasonable to assume that the corpus allatum of adult Muscidæ has a function similar to that of the corpus allatum of the adult female Rhodnius as found by Wigglesworth[1] (cf. also experiments of Weed on Melanoplus[2]), that is, to control the development of the ovaries. In order to test this hypothesis I removed the corpus allatum of rather



RELATIVE AREAS OF CORPORA ALLATA IN CASTRATED CALLIPHORA FEMALES (I) AND OPERATED CONTROLS (II)

newly hatched unfed females of Calliphora and Lucilia. It proved possible to extirpate the corpus allatum solely without damaging the aorta. The mortality was low; out of seventeen Calliphora which had their corpus allatum extirpated three died. After six days at 25° C. and normal feeding (sugar, meat and water) thirteen of the fourteen survivors showed small slightly developed ovaries, whereas one had large ovaries with nearly mature eggs. Thirteen of the fifteen operated controls (none of which died) had large nearly mature ovaries, and two had somewhat smaller ovaries with conspicuous nurse cells; but these ovaries were much larger and much more developed than the ovaries of the thirteen individuals from which the corpus allatum had been excised.

Fourteen about one-day-old unfed Lucilia females had their corpus allatum extirpated. After six days at 25° C. and normal feeding, nine showed small slightly developed ovaries; in one fly the ovaries were somewhat larger, two had ovaries with conspicuous nurse cells, and two had large nearly mature ovaries. Out of ten operated controls, one died, the surviving nine all showed large mature ovaries. The small ovaries of the flies without corpus allatum seem to have stopped growth at the same stage of development.

It would appear from these experiments that the corpus allatum of Calliphora and Lucilia females produces a hormone which regulates maturation of the ovaries, just as is the case in Rhodnius.

The growth of the ovaries in some individuals, in spite of the removal of the corpus allatum, may be explained in one of two ways:

(1) Already before the extirpation the corpus allatum has produced sufficient hormone to induce maturation of the eggs.

(2) A small piece of the corpus allatum may have remained in the animal and produced the hormone necessary for maturation of the eggs.

If the first hypothesis is the right one, it should be possible to determine a critical period for the effect of the hormone by using flies the age of which is exactly known. Experiments have been begun to test this.

In dissecting females of Lucilia, four flies were found to possess an abnormally large corpus allatum and very small undeveloped ovaries. According to the known age of two of these flies, they ought to have been mature. Two explanations seem to be possible:

(1) The corpus allatum has hypertrophied, but is functionless, and for this reason the ovaries remain undeveloped.

(2) There is a mutual influence of the corpus allatum and the ovaries. Some unknown factor has inhibited the development of the ovaries, although the corpus allatum still produces the egg-maturing hormone; but the abnormal ovaries have no effect on the corpus allatum, and so this organ hypertrophies.

If the second hypothesis holds true, removal of the ovaries from newly hatched flies ought to cause a similar enlargement of the corpus allatum as that seen in the abnormal individuals referred to. In this connexion it should be remembered that in some vertebrates castration brings about a considerable increase in size of the pituitary gland, an organ to which the corpus allatum of insects bears some resemblance.

To test this, fifty newly hatched Calliphora females had their ovaries extirpated. Out of these, thirty-one died (the mortality was very high at the beginning, later on I succeeded in lowering it considerably); after seven days at 25° C. the surviving nineteen showed an abnormally large corpus allatum. Out of thirty-five operated controls fourteen died; after seven days at 25° C. twenty showed fully mature ovaries and a considerably smaller corpus allatum than the castrated ones, whereas one fly had abnormal ovaries and correspondingly a very large corpus allatum. All the corpora allata of the castrated females as well as those of the operated controls were examined on living animals and drawn by means of a camera lucida. The areas of the drawings of the individual organs have been calculated and are shown in the two curves of the accompanying graph; to obtain the absolute sizes of the organs these values must be divided by 8,100 as the linear magnification used was 90. It is obvious, as one might have expected, that there is a considerable variation in both groups, but in no case is a corpus allatum from a control as large as a corpus allatum from a castrated female.

These experiments support the second hypothesis stated above. It thus appears that not only does the corpus allatum control the ripening of the ovaries

in the normal adult fly, but also the growing ovaries influence the size of corpus allatum, which in the absence of ovaries hypertrophies. As yet the precise nature of this action is obscure. The investigation is being continued.

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Nov 30.

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Bending of Glass under Long Continued Stress

I HAVE tried the following experiment. A piece of optically flat crown glass 3·5 cm. long, and 1·5 cm broad and 0·3 cm. thick, was supported on wood at the extreme ends, and the middle was loaded with 6 kgm. applied by means of a wooden chisel edge, which carried a weight moving in guides above. It remained in position from April 6, 1938, to December 13, 1939. At the end of that time the glass was taken out and tested on an optical flat by means of interference fringes. It was found to have been bent, the sagitta of the arc amounting to 2·5 bands or 1·25 waves, that is, about 6×10^{-5} cm.

RAYLEIGH.

Terling Place, Chelmsford.
Dec. 13.

Scattering of Mesons and the Magnetic Moments of Proton and Neutron

THE meson theory in its present form exhibits a number of difficulties which are connected with the particular way in which the conservation of charge and the spin enter the interaction between mesons and the nuclear particles. The expression for the anomalous magnetic moment of the proton and neutron[1], for example, diverges as $\int_0^\infty dk$. The cross-section for the scattering of mesons by a nucleus is found to be very much larger than experiments permit and increases rapidly with increasing energy. This would be incompatible with the high penetrating power of cosmic ray mesons. The cross-section for scattering of a longitudinal meson (rest mass μ) with energy ε (momentum p/c) is, according to the present theory, given by[2]

$$\varphi = 4\pi\left(\frac{g^2}{\mu c^2}\right)^2 \frac{p^4}{\varepsilon^2(\mu c^2)^2} \qquad (1)$$

From the analogy of mesons with light quanta, one would expect a cross-section of the order $(g^2/Mc^2)^2$, where M is the mass of the proton, and no increase with energy for $\varepsilon > \mu c^2$. The experiments by J. G. Wilson[3] have shown that the scattering cross-section even for an energy so low as a few times μc^2 (10^8 ev.) is smaller than (1) by an order of magnitude and does not increase with energy.

As can be seen from the computation of (1), both difficulties are due to the fact that the conservation of charge forbids a number of transitions which could occur if mesons were neutral particles[2]. A neutral meson could, for example, be *emitted and absorbed* by a proton. A positive meson can *only be emitted by a proton but not absorbed*. The cross-section for scattering would be of the right order of magnitude if we allow a positive meson also to be absorbed and a negative one to be emitted by a proton, etc., or, in other words, if 'proton states' with charges $-e$ and $+2e$ existed[4]. The introduction of those particles meets, however, with the following difficulties. First, particles of this nature are not observed and are unlikely to have escaped observation if they occur in heavy nuclei. Secondly, if a proton were capable of emitting also a negative meson, the negative meson would give a contribution to the anomalous magnetic moment of the proton of opposite sign and—all other quantities being equal—of the same value as the contribution from the positive meson. Thus, there would be no anomalous magnetic moment at all.

These difficulties can be overcome if we assume that the rest mass of the new particles is considerably *higher* than that of the proton, say, by 25–50 electron masses (see below). The particles would then be extremely unstable and would not play any part in the structure of heavy nuclei. Denoting the mass difference between the new particles and the proton by ΔM, the cross-section for the scattering of a longitudinal meson becomes, for $\varepsilon < Mc^2$, assuming $\Delta M \ll \mu$,

$$\varphi = 4\pi\left(\frac{g^2}{\mu c^2}\right)^2 \left\{\frac{1}{3}\left(\frac{\mu}{M}\right)^2\left(\frac{\mu c^2}{\varepsilon}\right)^4 + \left(\frac{\Delta M}{\mu}\right)^2 \frac{p^4}{\varepsilon^4}\right\}. \quad (2)$$

This expression does *not* increase with energy for $\varepsilon > \mu c^2$. If p is approximately μc^2, (2) is smaller by a factor $(\Delta M/\mu)^2$ than (1). A value $\Delta M/\mu$ of approximately 1/5 would be sufficient to bring (2) into harmony with the experimental requirements. For ε greater than Mc^2, φ will probably decrease owing to the relativistic features of the proton.

Similar considerations must be applied to the spin. The spin contributes also to the high scattering cross-section (for transverse mesons). This can be avoided if we introduce also 'higher spin states', for example, heavy particles with spin s of 3/2. Transitions from the normal proton state, s equal to 1/2, to these higher states under the influence of a meson field can be included in the theory in a very simple manner. In the present theory the spin-dependent interaction between a meson field φ and a nuclear particle is f/λ (σ curl φ), where σ is the spin matrix and has only matrix elements for $\Delta s = 0$. σ has to be extended in such a way as to include transitions $\Delta s = 1$. This can be done if we replace σ by the matrix of a dipole moment r/r. For transitions $\Delta s = 0$, the matrix elements of r/r and of σ are identical. If this is done, the cross-section for the scattering of transverse mesons also is small and of the order of magnitude (2). The physical significance of r/r is that of the *intrinsic* magnetic dipole moment of the proton, which is a characteristic feature of the meson theory (r is not, of course, the spacial position of the proton).

As a further result of our new assumptions, the anomalous magnetic moments diverge only *logarithmically*. Such a divergence can, at the present stage of the theory of the meson, scarcely be considered as a very serious difficulty. The relativistic features of the proton have so far been neglected, and it may well be that the logarithmic divergence would disappear if they are taken into account properly. As an upper limit for the validity of the meson theory in the form proposed above, we therefore take the rest energy of the proton. The anomalous magnetic moment of the proton then becomes (in units of the nuclear magneton μ_0)

$$\frac{\mu}{\mu_0} = \frac{16}{3\pi}\,\frac{M\,\Delta M}{\mu^2}\,\frac{f^2}{\hbar c}\left(\log\frac{2E_m}{\mu c^2} - \frac{4}{3}\right), \quad E_m \sim Mc^2. \quad (3)$$

This is of the right order of magnitude when $\Delta M/\mu$ is approximately $1/5$, which is the value assumed above.

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Nov. 28.

[1] Fröhlich, Heitler and Kemmer, *Proc. Roy. Soc.*, A, **166**, 154 (1938). Yukawa, Sakata and Taketani, *Proc. Math. Phys. Soc. Japan*, **20**, 319 (1938).

[2] Heitler, *Proc. Roy. Soc.*, A, **166**, 529 (1938), and Report of the Eighth Solvay Conference, Brussels, in the press, where the reasons for the high cross-section are analysed.

[3] Wilson, *Proc. Roy. Soc.*, in the press. I am very much indebted to Dr. Wilson for having sent me his MS. before publication.

[4] This possibility was first mentioned to me by Bhabha in a private discussion in connexion with his classical theory for neutral mesons. The whole problem was very much clarified in discussions with Bhabha, Fröhlich and Kemmer.

A Simple Rule for Evaluating Atomic Constants

FROM some of the fundamental constants, natural units can be formed, showing simple relations among many other constants[1]. The fine structure constant is the well-known example

$$\frac{2\pi e^2}{ch} = \alpha = \frac{1}{137} \quad . \quad . \quad . \quad (1)$$

Also α gives a simple relation between the velocity of the electron in the normal hydrogen atom and the velocity of light, and that between the radius of the electron and of the hydrogen atom in the normal state:

$$\frac{v_e}{c} = \alpha, \quad \frac{\gamma_e}{\gamma_H} = \alpha^2.$$

Now let us consider the two following length units: one is for charged particles, and the other for uncharged particles:

$$\frac{e^2}{m_e c^2} \equiv l_c \quad . \quad . \quad . \quad (2) \qquad \sqrt{\frac{Gh}{c^3}} \equiv l_u \quad . \quad . \quad . \quad (3)$$

The ratio of these two,

$$l_c/l_u = \frac{e^2}{m_e\sqrt{Gch}} \equiv A, \quad . \quad . \quad . \quad . \quad (4)$$

will be shown to play a similar part to α. In order to show that, let us employ the de Broglie wave equation in a wide sense.

$$\frac{h}{m_0 c} = l_{\max} \quad \text{and} \quad \frac{h}{M_{\max.}} = l_0, \quad . \quad . \quad . \quad (5)$$

where the subscripts max. and 0 denote respectively the maximum and minimum mass or length.

From (3) and (5)

$$\frac{l_u^2}{l_0} = \frac{M_{\max.}\,G}{c^2}, \quad . \quad . \quad .$$

which is also a length.

Comparing this with the well-known equation showing the relation between the mass and the radius of the universe, $\frac{M_u G}{c^2} = \frac{\pi}{2}R$,

we may write

$$\frac{l_u^2}{l_0} = \frac{M_u G}{c^2} = l_{\max}, \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where $M_{\max}$ and $l_{\max}$ are identified with the mass of the universe M_u and the longest distance in space, $\pi R/2$, respectively.

It is interesting to find the numerical coincidence in the two following cases:

$$\frac{M_u}{m_0} = 2A^6 \quad . \quad . \quad . \quad (7); \qquad \frac{M_H}{m_0} = 3A^2 \quad . \quad . \quad . \quad (8)$$

M_H denotes the mass of a hydrogen atom.

From (7) and (8)

$$\frac{M_u}{M_H} = \tfrac{2}{3}A^4 = N = 136 \times 2^{256}, \quad . \quad . \quad . \quad (9)$$

N being the total number of particles in the universe[2].

From (5), (6) and (7)

$$\frac{l_{\max}}{l_c} = \sqrt{2}A^2 \quad . \quad . \quad . \quad . \quad . \quad (10)$$

From (2), (3), (6), (9) and (10)

$$\frac{M_H}{m_e} = \frac{3}{\sqrt{2}}\,\frac{ch}{e^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

Furthermore, the Rydberg constant,

$$R_\infty = \frac{2\pi^2 m_e e^4}{ch^3} \quad . \quad . \quad . \quad . \quad . \quad (12)$$

With any three constants given, we can thus evaluate the rest. Now let us assume the experimental values of c, R_∞ and G, which are comparatively reliable[3].

$$\left.\begin{array}{lll} c & = & (2\cdot99774 \pm 0\cdot00005)\,10^{10}\ \text{cm./sec.} \\ R_\infty & = & (109{,}737\cdot42 \pm 0\cdot06)\ /\text{cm.} \\ G & = & (6\cdot658 \pm 0\cdot001)10^{-8}\ \text{cm.}^3/\text{gm.sec.}^2 \end{array}\right\} . \ . \ (4)$$

Then we can find the values of h, e, m_e and M_H as follows: The value of A is found in (9) to be $6\cdot9715 \times 10^{19}$, which is an absolutely definite number.

From (1), (4) and (12),

$$h = \left[\frac{c^3}{16\pi^2 R_\infty^2 (137)^6 A^2}\right]\frac{1}{G} = \frac{K_1}{G} \quad . \ . \ (13)$$

From (1),

$$e^2 = \left[\frac{c}{2\pi 137}\right]h = K_2 h \quad . \quad . \quad . \quad . \quad (14)$$

From (4),

$$m_e = \left[\frac{1}{A\sqrt{Gc}}\right]\frac{e^2}{\sqrt{h}} = K_3\frac{e^2}{\sqrt{h}} \quad . \quad . \quad (15)$$

From (1) and (11), $M_H = [3\sqrt{2} \times 137]\,m_e = K_4 M.$

The results agree closely with the experimental values as shown in the accompanying table.

Constant	Calculated value	Observed value[5]
h	$6{\cdot}6213 \times 10^{-27}$ erg sec ± 10	$6{\cdot}6189 \pm 36 \times 10^{-27}$ erg sec. $6{\cdot}6242 \pm 10$ $6{\cdot}6133 \pm 34$
e	$4{\cdot}8019 \times 10^{-10}$ E.S.U. ± 7	$4{\cdot}8025 \pm 4 \times 10^{-10}$ E.S.U.
m_e	$9{\cdot}099 \times 10^{-28}$ gm ± 1	$9{\cdot}1070 \pm 14 \times 10^{-28}$ gm $9{\cdot}1073 \pm 24$ $9{\cdot}0171 \pm 14$
M_H	$1{\cdot}6614 \times 10^{-24}$ gm ± 2	$1{\cdot}6617 \pm 17 \times 10^{-24}$ gm.
e/m	$1{\cdot}7605 \times 10^{7}$ E.M.U./gm ± 2	$1{\cdot}7591 \pm 2 \times 10^{7}$ E.M.U./gm.
h/e	$1{\cdot}3788 \times 10^{-17}$ erg sec/E.S.U. ± 2	$1{\cdot}3761 \pm 6 \times 10^{-17}$ erg sec/E.S.U. $1{\cdot}3782 \pm 7$ $1{\cdot}3773 \pm 1$ $1{\cdot}3771 \pm 7$

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[1] Eddington, "New Pathways of Science".
[2] Eddington, "Relativity Theory of Protons and Electrons".
[3] Bond, *Phil. Mag.*, 624 (1936).
[4] Michelson, *Astrophys. J.*, 82, 26 (1935).
[5] Dunnington, *Rev. Mod. Phys.*, (11), 78 (1939).

Landau Diamagnetism and the Fermi-Dirac Energy Distribution of the Metallic Electrons in Graphite

IT was discovered by Landau[1] that an electron gas should have, besides its spin paramagnetism, an appreciable diamagnetism due to the quantized orbital motions of the electrons in the magnetic field. If the electrons are *free*, the diamagnetic susceptibility per unit volume of the gas, when it is non-degenerate, is given by the Curie law

$$K = -\frac{n\mu^2}{3kT}, \quad . \quad . \quad . \quad (1)$$

and when it is completely degenerate by the temperature-independent value

$$K = -\frac{n\mu^2}{2kT_0}, \quad . \quad (2)$$

where n is the number of electrons per unit volume, μ is the Bohr magneton, T_0 is the degeneracy temperature defined by

$$kT_0 = \frac{h^2}{2m}\left(\frac{3n}{8\pi}\right)^{2/3}, \quad . \quad (3)$$

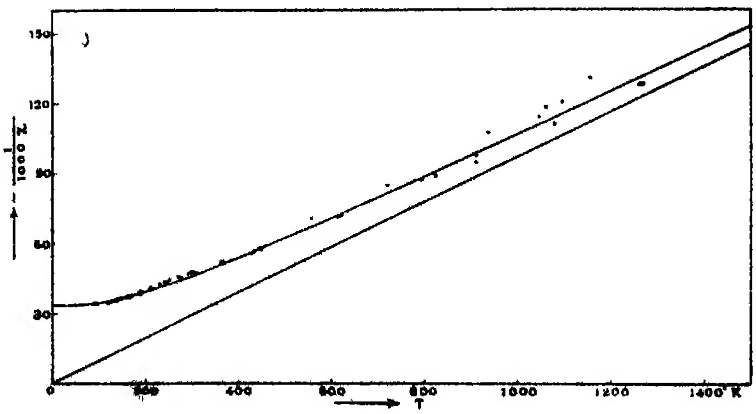
and the other letters have their usual significance. For such a gas the paramagnetic susceptibility is numerically three times the diamagnetic susceptibility and therefore predominates.

For the electrons in any actual metal, which are under the influence of the lattice field, the expressions for the two susceptibilities are naturally more complicated. In particular, the 3 : 1 ratio between them does not hold, and under special conditions the paramagnetic part of the susceptibility may become negligible in comparison with the diamagnetic part. When further, as in graphite, the metallic electrons can move about freely in a plane, and the freedom of movement is confined practically to the plane, the susceptibility along the normal to the plane will conform to equation (1) at high temperatures, and to (2) at low temperatures, the degeneracy temperature T_0 appearing in (2) being, however, much smaller than that given by (3) for electrons that are free to move in all directions.

These results have been verified in graphite. Its abnormal diamagnetism, which is confined to the direction of its hexagonal axis, conforms to equation (1) at high temperatures, and to (2) at low temperatures, with n corresponding to *one electron per carbon atom*, and $T_0 = 520°$ K.; at all temperatures (in the range investigated) the susceptibility per carbon atom is found to be the same as the diamagnetic susceptibility per electron of a Fermi free-electron gas the degeneracy temperature of which is 520° K. The theoretical values for the specific susceptibility (per gram) of graphite, χ, calculated on this basis, are represented by the accompanying curve, and it will be seen that the experimental values, which are denoted by circles, lie close to the curve[2]. The straight line which the curve tends to reach asymptotically at high temperatures is also drawn in the graph, and corresponds to equation (1).

That one electron per carbon atom should be free to move about in the basal plane agrees with the known structure of graphite. There is a Brillouin zone which can just accommodate 3 electrons per atom, which is a flat hexagonal prism bounded by {000,2} and {2$\bar{1}\bar{1}$,0}, and the energy discontinuities across all the faces of the zone are large. There is a bigger zone bounded by {000,2} and {2$\bar{2}$0,0} which can just contain 4 electrons per atom, but the energy discontinuity across {2$\bar{2}$0,0} is small.

The agreement between the experimental data and the theoretical curve plotted in the graph may be regarded as a convincing demonstration of Landau's value for the diamagnetism of a free-electron gas,



and of its temperature variation in accordance with the statistics of Fermi and Dirac

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[1] Z. Phys., 64, 629 (1930)

[2] The theoretical curve was plotted with the help of the tables for the Fermi-Dirac integrals given by Stoner, Proc. Leeds Phil. Soc., 3, 403 (1938). The experimental values are from the measurements by Krishnan and Ganguli, Z. Krist., A, 100, 530 (1939), and some unpublished measurements by Ganguli

Total Solar Eclipse of October 1, 1940

THE Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society has for some years plans prepared for a number of expeditions to observe, what should be a very good eclipse for study, the total eclipse of October 1, 1940. Prof. J. A. Carroll was to have gone from Aberdeen to Brazil with an objective interferometer and an echelon spectrograph for a study of coronal and chromospheric line contours and wave-lengths. The Royal Observatory, Greenwich, and the Cape Observatory were to have gone to Calvinia for a study of the Einstein displacement of stellar images, for a spectrographic study of the chromosphere with a moving-plate camera and for other work. Prof. H. Dingle was to have gone to a station near the edge of the belt of totality for work on wave-lengths and intensities of chromospheric lines near the cusp. The Solar Physics Observatory and the Radcliffe Observatory, Pretoria, were to have joined forces at Nelspoort for a programme including work on the extreme ultra-violet spectrum of the chromosphere and corona, a study of chromospheric line intensities at different heights with a camera having a plate moving intermittently, and polarization studies of the corona and of the sky close to the eclipsed sun.

The outbreak of the War has caused the abandonment of all the expeditions from Great Britain, and the Committee has decided to concentrate on one expedition from the Cape and Radcliffe Observatories to Calvinia. This will carry out as much as proves practicable of the programmes of the various expeditions originally planned. Just how much that will amount to remains to be settled, but every effort will be made to secure as wide a programme of observations as possible.

F. J. M. STRATTON.
(Secretary).

Joint Permanent Eclipse Committee of the
Royal Society and the Royal Astronomical Society,
Gonville and Caius College,
Cambridge.

Points from Foregoing Letters

A. I. Virtanen and M. Torniainen suggest that the discrepancies in their results and those of others experimenting on the excretion of nitrogen compounds from leguminous roots may be ascribed to the quality of the containers, and especially to their porosity. Observations show that the pots giving best results should be large and very porous

The effects of alkaline reagents on wool have been reviewed by M. R. Freney and M. Lipson. They find that the sulphur and nitrogen contents of merino wool are scarcely altered by immersion in 52 per cent sodium hydroxide up to 30 minutes; that the surface structure of the fibre is unaltered by similar treatment up to 5–10 minutes; that wool treated with concentrated sodium hydroxide absorbs acid dyes evenly; and that a woven fabric treated with 52 per cent sodium hydroxide solution shows a decrease in shrinkage on washing. These studies were extended to treatment of wools with alkalis dissolved in certain organic solvents.

H. Blaschko describes experiments on the inhibition of amine oxidase by derivatives of β-phenylisopropylamine; it is shown that there exists a parallelism between the awakening action of these drugs and their inhibitory effects on the enzyme.

A. Polson describes and illustrates an apparatus for studying the mobility of animal viruses and their neutralizing antibodies in an electric field. It is a simplified and less complicated modification of the Tiselius moving boundary method.

Ellen Thomsen finds that maturation of the ovaries in adult female flies is controlled by a hormone produced by the corpus allatum, since extirpation of the corpus allatum of young Calliphora and Lucilia females causes the ovaries to stop development at an early stage, whereas operated controls have fully developed ovaries. The ovaries on the other hand influence the corpus allatum, for removal of the ovaries of young Calliphora causes a considerable enlargement of the corpus allatum.

Lord Rayleigh has been able to detect by an interference method a slight permanent set of a strip of glass exposed for many months to a powerful bending moment.

W. Heitler points out that a number of difficulties (diverging magnetic moment of proton, large scattering cross-section for mesons) are due to an inadequate treatment of the spin and charge. It is suggested that 'higher proton states' with charge $2e$, $-e$, and those with spin 3/2 might exist with a rest mass of 25–50 electron masses higher than that of the proton. The cross-section for the scattering of mesons is then of the right order of magnitude and the magnetic moment of the proton diverges only logarithmically.

According to K. S. Krishnan, the abnormal diamagnetism of graphite along its hexagonal axis is the same as the Landau diamagnetism of the Fermi electron gas containing one electron per carbon atom and having a degeneracy temperature of about 520° K.

RESEARCH ITEMS

Osage Warfare

THE late Francis La Flesche, himself an Omaha Indian and a member of the staff of the Smithsonian Institution, Washington, among his numerous studies of the American Indians, made an elaborate record of the rites and ceremonies observed by the Osage Indians in connexion with the conduct of tribal warfare (*Bull. Bureau American Ethnol.*, No. 101, 1939. Washington, D.C.: Government Printing Office, 35 cents). Before taking any action against an enemy, a council meeting was held to choose a leader. This leader had to fast for seven days, and then three complicated and elaborate ceremonies had to be performed. The rituals making up the Wa-sha-be A-thin or war ceremony comprised twenty-eight separate songs, which, interspersed with processions, ceremonial dances and ancient rites, must be sung at just the right times, in proper order, and by the properly designated singers. The Osage, essentially a peaceful tribe who lived in three separate villages in Oklahoma, had also an elaborate peace ceremony, which was intended not only to promote peace within the tribe, but also with their neighbours. They held the peace ceremony in profound veneration because it was believed that the man who had formulated the rite had received supernatural aid in so doing. Though they were peace-loving, intolerable aggression by a neighbouring tribe would force them to take up arms. At the close of the war ceremony a band of warriors was dispatched to meet the enemy. If victory were achieved the band returned with scalps and prisoners, and victory songs were sung.

Distribution of Ceratium

E. STEEMANN NIELSEN has extended his previous researches (1934) on the Ceratia of the Pacific Ocean ("Die Ceratien des indischen Ozeans und der ostasiatischen Gewässer, mit einer allgemeinen Zusammenfassung uber die Verbreitung der Ceratien in den Weltmeeren". Von E. Steemann Nielsen. (Dana-Report No. 17.) Pp. 34. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press, 1939.) 3.50 kr.; 3*s*.). It was originally intended to add those of the Atlantic, but as these have been thoroughly dealt with by the two German Expeditions *Meteor* and *Deutschland* (Peters, 1932, and Schubert, 1937) this was considered unnecessary. It is now possible to give a general survey of the distribution of the three oceans and their neighbouring seas. Charts are given showing the distribution of the dominant species in the Indian Ocean and East Asiatic waters and tables of the horizontal and vertical distribution of all of them, with a review of their distribution in the different regions and the numbers in the Nansen net in the stations poor in plankton. The most striking fact that emerges is the homogeneity of distribution and the absence of geographic races or species. As was noted in the southern Pacific, the author regards the two factors temperature and oceanic-neritic influence as of supreme importance in the determination of the distribution of Ceratia. Schubert (1937) regards salinity as of great significance, but the observations of Peters (1932) in the Atlantic and of Nielsen in the Pacific and in the present work are opposed to this. It is agreed that extreme salinity is of importance; but within the limits shown in the open ocean it has apparently little influence on distribution of the Ceratia. The material came almost exclusively from tropical waters. It is found that all Ceratium species which can live in tropical waters are inhabitants of both hemispheres. The cold-water species are, however, only inhabitants of one of them. *Ceratium fusus*, which is well known from both warm and temperate water, inhabits both hemispheres. In the Antarctic there is the cold-water species *Ceratium robustum* inhabiting the whole region, and in the Arctic *Ceratium arcticum*. Most warm-water Ceratia are common to all three oceans, but there are certain forms of purely tropical species found only in the Indian Ocean and Pacific, or only in the Atlantic. This is especially the case with neritic species. The Indian Ocean and the Pacific represent one region so far as the purely tropical Ceratia are concerned.

Offspring from Artificially Activated Ova

S. PINCUS (*Proc. Nat. Acad. Sci.*, **25**, 557–559; 1939), following up his previous report that three litters of rabbits had been obtained from recipients of artificially activated ova, shows by further breeding that the transplanted ova which have been activated give rise to normal offspring without fertilization. For example, eighteen chinchilla ova transplanted after activation into an albino doe, which had been made pseudo-pregnant by pituitary extract, gave rise to two chinchilla females, one of which has been further bred by mating to an albino male, giving a second generation of nine chinchilla and three albino.

Seed Weight in the Tomato

THE weight of the seed and embryo in the tomato is dependent on the genotype of the plant, the external environment in which the fruits develop, and also upon certain internal factors such as the number of seeds developing in the fruit and the number of fruits on the truss. L. C. Luckwill (*New Phytol.*, **38**, 181–189, 1939) has calculated correlations and regressions between seed weight and these internal factors, and has estimated that variations in seed number may be responsible for variations in mean seed weight as large as 45 per cent. The maximum variation due to differences in the number of fruits developing on the truss was estimated at 10 per cent of the mean. It is suggested that these correlations may arise from causes connected with the nutrition of the developing ovules similar to those which give rise to the negative correlation between birth weight and litter size in certain mammals. These results have a great influence on the design of experiments on heterosis (see also NATURE, Nov. 25, p. 908).

Heterochromatin in the Chromosomes of Drosophila

B. P. KAUFMANN (*Proc. Nat. Acad. Sci.*, **25**, 571–577; 1939) has studied the distribution of 627 breaks due to X-rays in the *X*-chromosome of *Drosophila melanogaster*. He shows that there is no difference in frequency or distribution of breaks near or in an inversion as compared with wild-type chromosomes.

There is a significant increase of breaks in certain regions of the chromosome, particularly the known heterochromatin region, and in sections of the euchromatin part. From this and other evidence it is shown that the increased frequency of breaks in the sections of euchromatin is due to the presence of intercalary heterochromatin material.

Interxylary Cork

A PAPER in *Lloydia* (see p. 24 of this issue) by R. A. Diettert upon the morphology of *Artemisia tridentata* directs renewed attention to this interesting phenomenon When annual growth recommences in the stem in the spring a single layer of meristematic cells, the interxylary phellogen, remains on the surface of the last-formed xylem of the previous year. Quite late in the summer, in July and August, these initials give rise to several layers of cells which suberize progressively in a centrifugal direction As a result the wood of the current season is carried out on to a wider periphery by this late cork development; the rays are thus expanded and also the cells of the rays, in the region of the cork layer, are suberized progressively in an outwards direction We thus have the most recently formed layer of wood cut off from all older layers of wood by a sheet of periderm, a process that is repeated in successive years. This must have a most important effect upon the water economy of the plant, which has a wide distribution throughout the western United States E H Moss has directed attention previously to the presence of such rings of cork in herbaceous perennials (NATURE, 133, 689; 1934), concluding that they afford excellent protection against desiccation and various deleterious effects that might be associated with the dying down of annual shoots.

Softening of Rubber

CRUDE raw rubber as received by manufacturers has to be reduced by heating and mechanical working to a soft plastic condition to permit incorporation of the essential compounding ingredients. Experiments have been carried out by V. H. Wentworth and J. D. Hastings at the Rubber Research Institute of Malaya (*J. Rub Res. Inst. Malaya*, 9, Comm. 236 and 237) to determine if softening could not be more economically effected by modifying the preparation of the rubber on the plantation. A promising line of attack is the treatment of latex prior to coagulation with substances such as zinc soaps which bring about softening in the course of the normal smoking and drying processes. Pine tar is an effective softener in common use, and in view of the fact that it was found possible to incorporate large quantities into the latex, it is suggested that master-batch preparation on estates might be worthy of consideration by the manufacturers. The incorporation of emulsions of 'peptizing agents' into the latex in the pre-coagulation stage is another method which has been used during the last two years for softening purposes. It is now shown that the degree of softness achieved depends to a large extent on the temperature at which the wet sheet is afterwards dried, high temperature in the early stages assisting the softening markedly.

Control of Loose Smut Disease

THE original delicate method of controlling the loose smut fungi upon wheat and barley by dipping the seed in hot water for a short period has gradually given place to the more workable treatment of steeping for a longer time at a lower temperature. G. Howard Jones has designed an automatic apparatus for dealing with the seed on cereal improvement farms in Egypt (*Min. Agr. Egypt Tech. and Sci. Service Bull.* 220. Govt. Press, Bulâq, Cairo, 1939. P.T. 3). About 150 lb. of seed contained in a hopper is emptied into a wire basket within a heating bath by means of an automatic electric relay control apparatus which also switches on the heating units. Six hours later, the same apparatus rings an alarm; the wire basket is then hoisted from its bath and the seed spread upon trays to dry in the sun. The heating is accomplished during the night, so that full advantage may be taken of the drying effect of the sun, and thus a continuous series of daily treatments is maintained. Germination is affected to a slight, but commercially insignificant, extent by the process.

The Ogasima (Japan) Earthquake of May 1

THIS is the subject of three papers by T. Hagiwara, N. Miyabe, R. Takei and Y. Otuka (Earthquake Research Institute, Tokyo Imperial University, 17, Part 3, September 1939), who have studied respectively the shock and aftershocks, the deformations of the earth's surface and the geological implications. The earthquake occurred about 14h. 58m. on May 1, 1939, and shocks of the same magnitude followed twice with an interval of two minutes, in the neighbourhood of Ogasima and the neck of a small peninsula in the Akita Prefecture. The aftershocks which followed the main earthquake were observed by four portable seismographs installed temporarily in the peninsula, and these aftershocks were found to have had epicentres near to where the surface effects were greatest within the peninsula, but not all originated in one place. Hundreds of dwelling-houses were destroyed by the earthquake and a landslide which followed it, and 29 people were killed. The surface effects including damage to property, surface cracks and permanent movement were found to be greatest (1) in the neighbourhood of Kitaura-mati on the northern seashore, where also a cliff extending about one kilometre along the Japan Sea slid down to the sea and destroyed more than a hundred houses; (2) near the villages of Anden and Kotogawa where the damage was greatest and surface features most distorted; (3) on the northern slope of Kanpûzan volcano; and (4) in Katanisi-mura, in the narrow isthmus dividing Lake Hatirôgata from the Japan Sea. In several places where the ground was permanently deformed, the horizontal displacements were up to 3·9 m. whilst the vertical displacements ranged about 1 m. Yanosuke Otuka is of the opinion that these displacements were due to surface ground disturbance and that they had no tectonic significance. The landslide however was due to slipping along the bedding plane of the Kitaura sand and mud alternation of the Middle Neogene.

Meteorology of the Byrd Expedition

SUPPLEMENT No. 41 of the *Monthly Weather Review* of the U.S. Department of Agriculture, issued last October, is an account running to 377 pages of the meteorological results of the Byrd Antarctic Expeditions of 1928–30 and 1933–35, by C. Grimminger and W. C. Haines. Part of the data had been prepared in the Antarctic in 1929–30 by W. C. Haines and H. T. Harrison. Apart from the

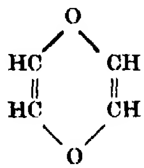
introduction, the volume is occupied by the tables in which the meteorological observations are set out. These include the observations made on the various ships of the Expedition between New Zealand and the Bay of Whales, those made at Little America (the base of the Expedition in lat. 78° 34′ S., long. 163° 56′ W., which was at nearly the same spot as "Framheim", where Amundsen obtained 10 months' records in 1911–12) and at the Bolling Advanced Weather Base, which was occupied by Admiral Byrd alone from March 26 to October 11, 1934, and on various sledging journeys. Upper air observations were made with the aid of kites carrying Marvin kite meteorographs. On the first expedition a kite meteorograph was installed on the aeroplane that formed part of the equipment, and on the second expedition an autogyro was taken, primarily for the purpose of making temperature observations, because of difficulties that had been encountered with kites. The best method of mounting the kite meteorograph was found to be that of suspending it within the fuselage to the rear of the cabin on rubber cords, ventilation being secured by having a tube of wind-proof cloth leading from an air vent in the top of the fuselage to the meteorograph. This enabled a perfect record to be obtained on the flight to and from the South Pole. The completeness of the meteorological record under the most trying conditions testifies to the keen work not only of the meteorologists but also of those who assisted, notably the leader of the expedition during his lonely vigil during the whole of an Antarctic winter night less than 10° from the Pole. In spite of difficulties arising from the intense cold, from drifting snow and frosting of the lenses of the pilot balloon theodolites, pilot balloon observations of upper wind were made at Little America on 569 occasions during the 310-day period when the pilot balloon station was in operation on the second expedition. A critical discussion of the results obtained will, it is hoped, be made in due course, although no objection can be made to this early publication of the raw material for such a discussion.

Structures of Ozone and Some Compounds

THE structures of ozone, silicobromoform ($SiHBr_3$) and dichlorogermane (GeH_2Cl_2) contain contributions from several forms among which resonance exists. The dipole moments of these substances have been measured by G. L. Lewis and C. P. Smyth (*J. Amer. Chem. Soc.*, 61, 3063; 1939), ozone being measured in solution in liquid oxygen, silicobromoform in heptane and dichlorogermane in carbon tetrachloride. The moments (in usual units) are O_3, 0·49; $SiHBr_3$, 0·79; GeH_2Cl_2, 2·21. The finite moment of ozone excludes the symmetrical triangular molecule in which each atom is linked to two others by a single bond. A linear molecule with a central atom joined to one on each side by identical bonds is also excluded. A bent structure, analogous to that of sulphur dioxide, seems indicated. The electronic structures which seem likely to the ground state of the molecule are the following: $:\ddot{\mathrm{O}}::\overset{+}{\ddot{\mathrm{O}}}:\underset{..}{\overset{-}{\ddot{\mathrm{O}}}}:$ $\quad :\underset{..}{\overset{-}{\ddot{\mathrm{O}}}}:\overset{+}{\ddot{\mathrm{O}}}::\ddot{\mathrm{O}}:$ $\quad :\overset{+}{\ddot{\mathrm{O}}}:\underset{..}{\ddot{\mathrm{O}}}:\underset{..}{\ddot{\mathrm{O}}}:$ $\quad :\underset{..}{\overset{-}{\ddot{\mathrm{O}}}}:\underset{..}{\ddot{\mathrm{O}}}:\overset{+}{\ddot{\mathrm{O}}}:$ and the first two, in which each atom has a complete octet of electrons, should make the largest contribution. All these structures are bent, the O—O—O angle being not less than 120°. It is concluded that the two oxygens linked to the central atom form an angle of about 140° and in any case very obtuse. The two identical bonds have some polar character as a result of resonance among forms containing semi-polar bonds. The results for silicobromoform and dichlorogermane show that silicon compounds tend to have minimum moments in the group of carbon, silicon, germanium and tin compounds, which, otherwise, increase in the order named.

Dioxadiene

THE compound used as the fundamental or parent nucleus for dioxane, dioxene and their derivatives, namely:



previously called dioxin, has now been prepared for the first time by R. K. Summerbell and R. R. Umhoefer (*J. Amer. Chem. Soc.*, 61, 3020; 1939) and called dioxadiene. It was obtained by the action of magnesium and magnesium iodide on 2,3,5,6-tetrachlorodioxane in boiling *n*-butyl ether (no reaction occurred in the lower boiling ethyl ether). Other reactions tried did not succeed. Dioxadiene boils at 75°, which is 26° lower than dioxane, it is insoluble in water, and in its chemical properties it behaves generally as an unsaturated ether. It is, however, more stable towards dilute acid than other unsaturated ethers such as dioxene and vinyl ether. It polymerizes in two to three weeks to a hard colourless solid, not melting below 250°, and insoluble in water, benzene, etc. Dioxadiene reacts vigorously with bromine and adds on hydrogen chloride. The reactions indicate that the unsaturation in the molecule is modified to a marked extent by conjugation with the ether oxygens.

Determination of Meteor Velocity from Zenith Attraction

IN a recent paper, Hideo Inouye shows how meteor velocities can be determined by finding the radiants of a shower at fairly short intervals when the radiant is not far from the meridian (*Mon. Not. Roy. Astro. Soc.*, 99, 9; October 1939). The observations are made when the radiant is near the meridian because the effects of the diurnal aberration in displacing the radiant are then negligible. It is well known that the attraction of the earth on a meteor causes a movement of the radiant towards the zenith, and the amount of this movement depends upon the velocity of the meteor and also on the distance of the radiant from the zenith. From the displacement of the radiant when it is at various altitudes an angle θ can be easily found, and from this latter the value of the velocity is read off from a table. An example is given from the Leonid shower of November 13, 1937, and from this the velocity of the meteors associated with this shower is 59·5 km./sec. The actual value is 71·4 km./sec., and it is suggested that this can be explained by errors of observation in the amount of the displacement. Although the method is interesting, it does not lend itself to very high accuracy.

COPROPHAGY IN THE RABBIT

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COPROPHAGY in the rabbit was discussed in NATURE (1939) under the title "Does the Rabbit Chew the Cud ?" and the early observations of Morot (1882)[1] were confirmed by Madsen[2] and by Taylor[3]. These observations showed that two kinds of fæces were voided by the rabbit, the familiar dry pellet type during the day and a soft mucous type during the night, rarely observed because the animal collects them directly from the anus and swallows them again. Madsen suggested that the difference in the two types was due to an intestinal rhythm in the rabbit itself and that refection was a normal physiological process in this animal Taylor, on the evidence of coccidial oocysts found in the stomach and of experimental feeding with lycopodium spores, agreed with Madsen and emphasized the necessity for recognition of this peculiar attribute of the rabbit in the correct interpretation of parasitological and physiological work in which this animal is employed. In the latter connexion he cited specific experiments of mine on the fate of ingested copper, some of the data of which may be more fully discussed.

In one of the earlier experiments it was observed that the elimination of 50 mgm. of copper (as the sulphate, dried on to food) was spread over five weeks: 22·5 mgm. appearing in the first week, 14 mgm. in the second, 6·4 mgm. in the third, 2·4 mgm. in the fourth and 1·3 mgm in the fifth week, the remaining 3·4 mgm. being probably accounted for by summation of analytical error over some 35 analyses Other evidence was available that the retention of such large quantities of copper could not be due to absorption from the alimentary tract and storage within the body with subsequent elimination, and the only rational explanation seemed to be refection of the copper-containing fæces. Since, however, half the quantity of copper finally accounted for was still present in the tract after a week, calculation shows that 80–90 per cent of the total fæces excreted must have been re-eaten, according to the interval assumed for complete passage of food through the tract, or 4–9 times the amount which actually passed through the wire-mesh floor of the cage. Such a high degree of refection seemed incredible even with an animal receiving a quantity of food well below its maximum appetite level.

On repeating this experiment, killing the animal after a week and analysing the contents of the tract, the tract itself as well as the major tissues, 38 mgm of the copper fed were found to have appeared in the fæces during the week as against 22·5 mgm. in the previous experiment and a further 12 mgm. were found in the contents of the tract (2·5 mgm. in stomach, 1 mgm in the intestines, 5 mgm. in the cæcum and 3·5 mgm. in the rectum) while the wall of the tract itself and the tissues contained only the usual 0·2–0·5 mgm per cent fresh material. The high amount of copper found in the stomach contents afforded particularly strong evidence of refection, and calculation from the observed excretion of copper suggested reconsumption of 50–70 per cent of each day's rectal deliveries.

Another experiment with a rabbit provided with a wooden collar, presumed large enough to prevent the animal getting at its anus, was undertaken, and the dry matter and copper fæcal excretion studied. In a five days preliminary uncollared period, an average daily excretion of 9·5 gm. dry matter was observed, of the ordinary familiar pellet type. After attaching the collar, 54·5 gm. dry matter appeared within twenty-four hours, 37·5 gm. being present in the normal 'day' fæces and 17 gm. in the softer 'night' fæces type, consisting of mucous covered agglomerates of much smaller pellets suggestive of loganberries. On the assumption that 9·5 gm. dry matter would also have been obtained on the sixth day but for the collar, the actual appearance of 54·5 gm. suggests that 45 gm. would have been eaten had the animal been able to get at its anus, a calculated 'refection level' of 82 per cent of the total excretion. This is astonishingly high and may perhaps have been accentuated by irregularity of rectal evacuation although there is no reason for such an assumption.

50 mgm. of copper had again been incorporated with the food the day the collar was attached and 96 per cent was recovered in four days: 10 mgm. on the first day, 25·5 mgm. on the second; 6·9 mgm. and 5·7 mgm on the third and fourth days respectively; the remaining 4 per cent appeared over the next few days This presumably represents the ordinary rate of passage through the tract, the lag over the third and fourth days probably being explained by the large storage capacity of the cæcum, and is in striking contrast to the behaviour noted in rabbits allowed to practise their customary coprophagy.

Excluding the first day of high fæcal excretion after collaring, the average dry matter over the next fifteen days was 13·7 gm. daily, 4·2 gm. more than in the five uncollared days on the same ration. This at least suggests that refection increases the extent of digestion of the dry matter of the food, and taking the daily dry matter intake as 37 gm., digestion coefficients for the collared period were 63 per cent, and for the uncollared period 77 per cent when the material was passed through the tract several times. As showing the extent of the craving for fæces, after twelve days the rabbit discovered a cunning method of circumventing the collar and was able to secure occasional pellets from the anus although often rolling over in the process.

On replacing the collar by a larger one and again feeding 50 mgm. copper a few days later, 6·5 mgm. appeared within twenty-four hours. The collar was then removed. Less than 4·5 gm. dry matter appeared over the next twenty-four hours and copper recovery diminished although the output of fæcal matter again rose and a further 36·5 mgm. copper were recovered in the ensuing seven days. On again replacing the collar practically all the remaining copper appeared in two days, during the first of which the fæcal dry matter rose from 13 gm. to 28 gm. with the reappearance of 'night' fæces. Again on the assumption that the actual rectal output was the

same as on preceding days, the drop of fæcal dry matter actually collected, 13·7 gm. to 4·5 gm., represents a refection of 9·2 gm. or 67 per cent of the total passing the anus. Similarly when the collar was next replaced the rise in fæcal dry matter from 13 gm to 28 gm. represents a minimum refection of 15 gm or 54 per cent—the real figure being higher if one assumes a tendency to greater retention in the tract when refection is suddenly prohibited.

Naturally the degree of refection varies with each individual rabbit, with the amount of food, probably with the chemical composition of the food and with disturbance of habit by intermittent collaring In the last mentioned experiment the refection level apparently varied from 54 to 82 per cent at different periods, and in the first experiment, in which elimination of copper was spread over five weeks, the average daily refection must have exceeded 80 per cent of the total fæces passing the anus.

A further point of interest is the difference in ash content, on a dry matter basis, between 'day' and 'night' fæces on the particular diet employed: 6·5–10 per cent in the 'day' fæces and 11·7–14·5 per cent in the 'night' fæces. Further investigations are in progress regarding other differences in chemical composition and on the relation between time of feeding and the appearance of pellet types.

[1] Morot, Ch., *Mém Soc. centr méd vét*, 12, Sér. 1 (1882).
[2] Madsen, H, NATURE, 143, 981 (1939).
[3] Taylor, E L., NATURE, 143, 981 (1939).

CHARITY AND THE STRUGGLE FOR EXISTENCE*

T H HUXLEY in his famous Romanes Lecture startled the University of Oxford by saying, or seeming to say, that the cosmic process as represented by the struggle for existence "works not for righteousness but against it" Apparently his contention was that the use of tooth and claw was to be contrasted with the more civilized methods of maintaining the race in being Huxley, however, did not define the precise function to be attributed to the higher morality as a means of survival. It remains, therefore, for the anthropologist to inquire what actual evidence there is for the view that what is salvation for the brute, or even for the savage, spells damnation for a reasonable being knowing good from evil

"Real progress is progress in charity, all other advances being secondary thereto"[1]. Huxley himself would have been the first to insist that what he terms ethical process involves 'charity' as a typical manifestation of pure goodness If 'charity' then be taken as a mark of the spiritual man, how far does a disposition towards it set him at variance with his former self, the natural man ?

Now, on the plane of anthropology, Dr. Marett disclaims at once any intention of trying to determine more than the biological function of morality, and in particular that of charity as its crowning grace. This method can at least furnish an external criterion of their worth. On a long view, such as that taken by the anthropologist, it becomes plain that certain types of conduct are of greater biological advantage than others—that they promote the survival of those who live accordingly. Further, they have the advantage that the anthropologist, who must with his evolutionary outlook insist on continuity at all costs, can recognize in man a steadily increasing purpose to make the best of his life, and he cannot but treat primitive and advanced morality as lineally related expressions of the same basic motive.

Charity would seem to be rooted in mother-love, on which the protracted infancy of our species makes it specially dependent; for they both involve a like readiness to give regardless of desert and with no thought of a return. At the same time, having regard to certain tendencies in human nature in virtue of its bi-sexual constitution, justice may be linked with fatherhood, while a certain virtue which may be roughly identified with holiness represents the effort to transcend the psychological opposition between them

Justice then may be regarded as the outcome of male masterfulness, which in course of time establishes a system of rights and duties having strict reciprocity as its ideal limit Father-right, however, has prevailed over mother-right in the evolution of the greater society, so that modern civilization is threatened with a type of authoritarian State given over to a harsh legalism insufficiently tempered by mercy. That so one-sided an exploitation of man's spiritual resources is unhealthy is possibly illustrated by the fact that the world's successive civilizations, all alike built up on power politics, hitherto have invariably come to grief.

Family life, however, outlasts the decay of nations; and for the anthropologist, it is suggested, the key to the understanding of human development on its moral side is not so much the evolution of the State as that of the family. In no department of life has experiment played a greater part, though only on the cultural side is this possible, since the biological conditions are virtually fixed. It might even be argued that the whole social process is fundamentally an attempt to resolve the temperamental conflict of sex into a harmony sufficient to ensure the continuation of the species

Here then in family life lies the best hope of striking a balance between gentleness and firmness in human intercourse.

As for what has here been called holiness, the history of religion shows that there have always been high-minded persons who tended to turn away from sex as too disturbing a factor in the moral life. But to starve by way of sublimating sex can at best be but an indirect way of promoting the survival of the race. It must be left rather to ordinary men and women to make their characteristic but diverse contributions to a morality which will ever consist in a compromise between discipline and love. Such is the two-fold aim of that traditional nurture which has become man's second nature and alone can bring him safely through the ages that lie ahead.

* Charity and the Struggle for Existence (Huxley Memorial Lecture for 1939). By Dr R. R. Marett. Pp 14. (London: Royal Anthropological Institute, 1939.)

[1] "Head, Heart and Hands", by R R. Marett, p. 40. (London 1935.)

SOME INDIAN ORIGINS IN THE LIGHT OF ASTRONOMICAL EVIDENCE

AMONG recent communications to the Royal Asiatic Society of Bengal, several dealing with details of a technical character in palæographical and historical studies bear upon points of interest and importance in the archæological investigation of the origin and development of Indian civilization*.

In a discussion by S. N. Chakravarti of the development of the Bengali alphabet from the fifth century A.D. to the end of Mohammedan rule, in which the argument depends upon a detailed examination of variations in form, the Bengali alphabet is derived from a proto-Bengali of the tenth century, which in turn it is suggested can be traced back to certain ancient prototypes in the pictographic script of the Indus Valley civilization. It is also suggested that the Indian system of notation, for which affinity with Egyptian demotic has been indicated, is in reality indigenous in origin, probably to be traced back to the seals of the Indus Valley.

Conclusions of a more surprising character, based on astronomical evidence, have been formulated by P. C. Sengupta in a series of papers discussing chronological and other problems in early Indian history. The first of these deals with the date of the Bhârata battle, the great conflict which forms the central incident of that great monument of early Indian literature, the Mahabharata. The date for this battle, as usually accounted, is indicated by three lines of traditional evidence at 3102-3101 B.C. The author, on an examination of one of these traditions, the evidence of the Yudhiṣṭhira era, has shown that the astronomical references justify the inference that the great battle took place in 2449 B.C. He now turns to examine the remaining two traditions, the Âryabhata and the Purâṇic traditions.

The calculation depends upon the dating of the Kaliyuga, which the Mahabharata states had just begun and to which the date February 3102 B.C. is assigned It cannot, however, be reconciled with the astronomical Kaliyuga, and is shown to be based upon an astronomical calculation in which conditions are correct only for A.D 499, when the Hindu scientific Siddhantas came into being It depends upon an incorrect assumption of the position of the solstices of Pandava times and an incorrect annual rate of the precession of the equinoxes. A corrected back calculation from conditions in the heavens corresponding to those recorded in the Mahabharata, that is, conditions in the period February 1924–35, gives a date January 10, 2454 B.C. as the beginning of this Kaliyuga era, and 2449 B.C. as the year of the battle

This leads to further inquiry as to observation of the solstices in successive ages. This was determined by the phases of the moon in the month of Mâgha, a lunar month of which the beginning at the present time may be from January 15 to February 11. In the calendar of the Vedic Hindus, this month started the five-year cycle which began "when the sun, the moon and the Dhaniṣṭhâs (Delphinus) cross the heavens together; it is the beginning of the Yuga, of the month of Mâgha or Tapas, of the light half and of the sun's northerly course". From the astronomical conjunctions to which reference is made in the Mahabharata, it would appear that this reckoning was started (traditionally by Brahma) at about 3050 B.C.

There are three peculiarities of this month: (1) it began with a new moon near Delphinis; (2) the full moon was near Regulus; (3) the last quarter was conjoined with Antares. Such a month did not come every year, but it was the standard month of Mâgha. In our own times it occurred in 1924 during February 5–March 5, a year which for the purpose of this investigation is taken as the gauge year.

References in the Brahmanic and other works directly state or indicate the winter solstice of successive Vedic periods. From these astronomical references fixing the position of the moon in relation to the winter solstice and the beginning of the month Mâgha, a matter of ritual importance in connexion with the year-long and other sacrifices, it has been possible to fix by calculation back from the corresponding conditions in recent years a series of dates beginning with 3550 B.C., the earliest date of the age of the Brahmanas, and covering a period of 1,450 years with a possible error of 400 years. It was thus during this period that the Brahmanic literature developed.

Next is considered Madhu-Vidyâ, or the "science of Spring" which as here interpreted is really the knowledge of the celestial signal for the coming of spring, addressed to the Aśvins, who are identified with α and β Arietis, the prominent stars in the Aśvini cluster. The three stars, α, β and γ Arietis, form a constellation which is likened to the head of a horse. The Aśvins are spoken of in several passages of the Rig-Veda as riding in the heavens in their triangular, three-wheeled, and spring-bearing chariot.

From certain references it would seem that when the car of the Aśvins first becomes visible at dawn, spring began at some place in the latitude of Kurukṣetra in the Punjab. The jealously guarded Madhu-Vidyâ or "science of Spring" was thus nothing but knowledge of the celestial signal of the advent of spring—the heliacal rising of α, β and γ Arietis.

By astronomical calculation it can be shown that this event at the latitude mentioned took place at, say, 4000 B.C. Hence it is beyond question that the Vedic Hindus could find accurately the beginnings of winter, spring and all seasons of the year.

The earliest epigraphic evidence of Vedic chronology from cuneiform inscriptions referring to Indra and other gods of the horse-riding Kharri or Mitanni dates from about 1400 B.C. In the absence of further epigraphic evidence, it is pointed out, this definite finding of the astronomical evidence derived from the literature as to the antiquity and chronology of the Vedas must be allowed to stand. It establishes, it is maintained, that the civilization of the Vedic Hindus was earlier than that of the Indus Valley as evidenced by the remains at Mohenjo-daro.

Finally, in "When Indra became Maghavan", Mr. Sengupta turns to the relation of the Vedic god Indra, the "shedder of rain" and "the wielder of

* See *J. R. Asiat. Soc. Bengal, Letters*, **4**, 3 (1938); issued September 1939.

the thunderbolt" to the summer solstice. The references to this god in the Rig-Veda, when divested of all allegory, suggest that he is the god of the summer solstice, while the clouds as represented by a demon are unwilling to yield up their watery store until assailed by the thunderbolt hurled by the god.

The monsoons which bring the rains usually burst about June 22 and there is usually a drought which lasts for about a month before the monsoon comes The demon Suṣṇa (drought) is killed by Indra. The fight with Vṛtra or Ahi, the cloud demon, is thus an annual affair which takes place when the sun enters the summer solstice, Indra withdrawing his rain-giving (or annual) bow with the coming of autumn.

When did Indra become the slayer of Vṛtra ? The answer given by the Rig-Veda is when Indra by the rising of Maghas became Maghavan. Maghas to us must be the constellation Maghās consisting of α, η, γ, ζ, μ and ς Leonis, at the heliacal rising of which the sun reached the summer solstice at the latitude of Kurukṣetra (lat. 30° N.). This it is shown must have happened in 4170 B.C.

APPLICATIONS OF PHOTOGRAPHY TO ENGINEERING

IN a paper delivered to the Junior Institution of Engineers on November 4 and published in the journal of the Institution for December, Mr. A. H. Styring gives an account of several practical applications of photography to engineering. He lays special stress on infra-red photography, photography by polarized light, X-ray photography and high-speed photography.

Infra-red sensitive materials have proved of the greatest value in spectroscopy and astronomy. Photographs of the solar spectrum have revealed lines as far as 13,500 A. wave-length. Distance appears hazy on non-colour sensitive materials because the suspended particles of water vapour in the atmosphere, which are transparent and therefore affect vision only slightly, act as a thick medium for deep violet and ultra-violet waves, scattering them, and producing an effect similar to that which would be seen if we were to try to look through a sheet of finely ground glass.

When photographing at great distances, the best results are obtained with infra-red sensitive materials and filters. Infra-red waves are less easily scattered by water and dust particles in the intervening atmosphere than are the shorter rays in the normal visibility range. The power of haze penetration is important and has an engineering application. Research is in progress for the adaptation of infra-red sensitive materials for navigational purposes. Good work has been done up to six miles, and distances up to twenty miles have been claimed. Special infra-red cameras have been fitted to trans-Atlantic liners in which infra-red film is exposed at 20-second intervals, each picture being developed and fixed rapidly for viewing in roughly one minute. In the same way application has also been made for military purposes, permitting vision of objects invisible to the eye. Other applications depend mainly on the fact that many dyes and pigments, which absorb strongly in the visible region, either transmit or reflect freely in the near infra-red region. In consequence it is possible to reveal by infra-red photography many structures invisible to the eye, and to differentiate between materials which to the eye appear similar. This has a useful application in photomicrography. Another promising field lies in the direction of research in the realm of elevated temperatures. Heat rays are recorded by infra-red materials.

Polarized light photography is based on the fact that light reflected from a non-metallic surface at an angle of 32–37° is strongly polarized. At other angles except 90° it is to variable extents. For this reason the reflection from natural things, separately and combined, has much of the light polarized. The unaided eye fails to detect this, but many objects viewed by a polarizing screen assume a new and strange beauty The use of polarized light in photography is made possible by the way in which all natural substances reflect polarized light When a ray of light falls on a sheet of paper, for example, the light that is reflected is composed of two parts, which are called 'specular' and 'diffused' components The specular component produces 'gloss' and enables us to see more or less distinctly an image of the source of light. If we look at our object through a polarizing screen, we find that we can orient the screen so that practically all the specular reflection is stopped and we see the object by diffusely reflected light. Polarizing screens have recently been made from a quinine-iodine compound called 'Herapathite', a thin layer of the substance being cemented between two sheets of plane glass The use of such a screen permits photographs to be taken obliquely through water or glass.

The principal application of X-rays to industry is the examination of articles during manufacture. Increased penetration is constantly being achieved and the definition of radiographs has been greatly improved. It does not necessitate expensive castings or forgings being either sawn asunder or otherwise destroyed or mutilated. With a little experience. defects such as gas cavities, sand and slag inclusions, metal segregation, etc., can be easily detected. The atomic weight of the substance examined has a marked effect on the depth of penetration of the rays. Apart from this fact, penetration depends on the voltage applied to the tube. For example, 40,000 volts will penetrate 4 in. of aluminium, but it requires 250,000 volts to penetrate 4 in. of steel. The gamma radiations of radioactive substances have latterly been employed for the same purposes as X-rays. Owing to their shorter wave-length the gamma rays have a much greater penetrative power.

The author points out that with high-speed photography, the ordinary type of motion camera which has an intermittent film motion and shutter can only be speeded up to ten times its normal speed before rupture takes place. Cameras operating at higher speeds have continuously moving films. In the mechanism of the high-speed camera perfected by the Western Electric Co. and Kodak Ltd. there is incorporated a clock, and this records the exact time when each event in a cycle takes place.

FLUID FILLING-MEDIA FOR ELECTRICAL APPARATUS

THIS paper, written by F. Meyer of the General Electric Co., was allocated for reading to the Institute of Electrical Engineers on November 23 and is now published. The author discusses the everyday fluid insulators used for electrical apparatus, particularly with transformers, and advances suggestions for improving the British Standard Specification (148, 1933, Insulating Oils for Electrical Purposes). In addition he discusses the properties of chlorinated diphenyls, perhaps the commonest non-inflammable liquids used for this purpose, which are known in America under the technical name 'pyranol'. The particular requirements of oils suitable for condensers are also considered.

When oil was first adopted for filling transformers and switchgear, use was made of the best existing kind of oil. Going back no farther than thirty years ago, we find that oils were fully approved that would now be instantly rejected, both with regard to their electrical properties and their other physical characteristics. In successive editions of the British Standard Specification 148, the requirements have been tightened up until the oil which satisfies Spec. 148 could be safely used medicinally. Unfortunately the demand of the transformer manufacturers was for an oil based on its sludge value and tested by a method far removed from service conditions, and very little attention was paid to its other properties. It is a well-known fact that the oxidation products of an oil at 150° C. are very different from those taken at 90° C. both in quantity and character. As a test for the eradication of unsuitable oils the author thinks that the Michie test has outgrown its original use.

Fifty per cent of the transformer oil used to-day is Grade *A* oil, typical examples of which give practically zero sludge values. For switchgear purposes where sludge is of small importance, highly refined oil is quite unnecessary. The less refined also the oil the cheaper it is, a point of importance when we consider the large bulk of oil used. Class *B* oils, which formerly were just obtainable with sludge values between 0·7 and 0·8, are to-day readily procurable at the low figure of 0·3 or even less. The author points out that in bringing the sludge value of oils down to these low limits the danger of the development of acidity is now as menacing as the old danger of high sludge values was. It may well be that in the light of modern experience, the highly refined *A* oils employed so widely to-day which have practically zero sludge value will be discarded and an oil of a moderate degree of refinement, but low developed acidity, will become the standard of transformer oil. Tests of *A* and *B* oils taken over a period of six months show that the rate of acidity increases for both oils, for the first three months is much the same but for the next three months the average acidity of the *A* oil increases much more rapidly than the *B* oil.

The greatest drawback of oil as a filling medium is its inflammability. In consequence of recent disastrous fires at Bradford and Kingston due to the oil in transformers and switchgear, and also the danger of fire from incendiary bombs, engineers have been recently studying closely the only non-inflammable liquids at present available, that is, synthetic chlorinated compounds. The commonest of these are the chlorinated diphenyls made in America and on the Continent but not yet manufactured in Great Britain. The degree of inflammability of pure chlorinated diphenyl, generally called in Great Britain 'aroclor', depends on the degree of chlorination. Experiments demonstrate not only the non-inflammability of 48 per cent chlorinated aroclor but also that, in addition, it has the valuable property of acting as a fire extinguisher.

In conclusion, the author discusses condenser oils, which are generally pure mineral hydrocarbon oils. Service conditions in this case are so severe that they cannot be used as delivered by the oil refiners, which can safely be done with transformers.

ROAD SURFACE TEXTURE PRINTS

THAT surface texture is an important factor in determining the resistance of a road to skidding has long been recognized, and at the Road Research Station one of the studies which has received attention has been the development of a satisfactory method of recording this quality. The latest device is an adaptation of the method of offset printing, and it is also the simplest and the most revealing in that it readily lends itself to a study of the changes which occur during the life of the road carpet and of its progress towards failure. A few square inches of the road under examination are cleaned of dust and then carefully inked over either by an ordinary half-tone black printing ink diluted with paraffin or by a water letterpress ink. A clean rubber roller, of specified hardness, is then run over the inked area and the impression taken by the roller is transferred to a sheet of white paper.

The prints which are obtained in this way are remarkable for the wealth of detail which they exhibit, even the finest particles on the surface, about a thousandth of an inch in diameter, being recorded. A Bulletin—Road Research Bulletin No. 3 ("A Printing Method of Recording Road Surface Texture". H.M. Stationery Office. 9*d*.)—just issued by the Department of Scientific and Industrial Research and the Ministry of Transport, gives a description of the process and of the apparatus which, it may be mentioned, packs into a suit-case. It exhibits a number of reproductions of prints taken by the process and these show the stones in the road surface appearing as in relief, the shading of the ink giving a stereoscopic effect. The interpretation of the prints requires experience, and though a surface likely to be slippery is easily recognizable, the assessment of the relative slipperiness of various carpets from their texture prints is more difficult. A series of these prints exhibits the changing nature of a given road surface; the prints are very convenient both for comparison and for storage.

PLANKTON OF THE JAVA SEA*

AN interesting preliminary investigation into the plankton of the Java Sea by Dr. H. C. Delsman shows that the coastal waters contain much plant and animal life and that towards the central part larger animals abound The two monsoons, the east monsoon about September and the west monsoon about February, have an important influence on the currents.

Two special cruises were made across the Java Sea, from Java to Borneo and from Borneo to Java, when a number of stations were made. The first cruise was in April at the end of the wet, west monsoon, the second in October at the end of the dry, east monsoon Vertical hauls were also made from near the surface to near the bottom. A comparison of the catches shows that the volume of plankton is higher in October, even if it is taken into account that at this time the larger organisms predominated, such as salps, siphonophores and mysid and amphipod crustaceans. The diatom plankton was generally found along the coasts, whereas the zooplankton was greater farther out and in the middle of the Java Sea, where diatoms were practically absent but where, sometimes, there were masses of Trichodesmium. The coastal plankton is generally of a finer composition, and besides diatoms contains numbers of the smaller copepods. Copepods, both small and large, abound and are the main food of the plankton-eating fishes.

The largest and commonest copepod is *Undinula vulgaris*, reaching in the female 3 mm. in length. This species is absent near the coast at both seasons and is found at a maximum away from the coast but is not present in the middle of the Java Sea In April it appears in greater numbers than in October. Fishes sometimes have their stomachs full of Undinula, which in value as fish food may be compared with *Calanus finmarchicus* in other seas. *Labidocera acuta*, another large copepod, apparently occurs under more oceanic conditions, occasionally replacing Undinula. The presence of the larger species of copepods at a certain distance from the coast is of much importance in connexion with the fisheries, and further studies in this direction should be of great value. This part of the sea is already a favourite place for the mayang fishers to put out their nets for carangids and clupeoids, presumably where their copepod food is most abundant.

It is found also that the structure of the gill rakers of the plankton-eating fishes, their shape and the nature of the eyes are different in the different regions Those clupeoids which feed in the coastal waters on the fine plankton have finer and more numerous gill rakers; those feeding a certain distance from the coast, where the plankton is much coarser and probably swallowed more discriminately, have much coarser gill rakes, a more slender body and larger eyes, thus being more capable of darting after their prey. The higher the number of gill rakes the greater their length and the smaller the diameter of the eye.

It is to be hoped that these preliminary plankton studies will lead to others on a larger scale.

* "Preliminary Plankton Investigations in the Java Sea" By Dr. H. C. Delsman. (*Treubia, bijdragen over Zoologie, Hydrobiologie en Oceanographie van den oost-indischen Archipel* Deel 17. Aflevering 2. July 1939.)

SEVENTY YEARS AGO

NATURE, vol. 1, January 6, 1870

Plea for the Mathematician

PROF J. J. SYLVESTER, F.R.S., in an article based on his presidential address at Exeter to the Mathematical and Physical Section of the British Association said · "Some people have been found to regard all mathematics, after the 47th proposition of Euclid, as a sort of morbid secretion, to be compared only with the pearl said to be generated in the diseased oyster, or, as I have heard it described, 'une excroissance maladive de l'esprit humain'. Others find its justification, its 'raison d'être', in its being either the torch-bearer leading the way, or the handmaiden holding up the train of Physical Science . . . What is it to us, they say, if the three angles of a triangle are equal to two right angles, or if every even number is, or may be, the sum of two primes, or if every equation of an odd degree must have a real root? How dull, stale, flat and unprofitable are such and such like announcements! . . . But this is like judging of architecture from being shown some of the bricks and mortar, or even a quarried stone of a public building—or of a painting from the colours mixed on the palette, or of music by listening to the thin and screechy sounds produced by a bow passed haphazard over the strings of a violin."

Force of the Human Heart

IN an article on "The Labouring Force of the Human Heart", the Rev. Prof. Haughton, F.R.S., states that "its energy equals one-third of the total daily force of all the muscles of a strong man; it exceeds by one-third the labour of the muscles in a boat-race, estimated by equal weights of muscle, and it is twenty times the force of the muscles used in climbing, and eight times the force of the most powerful engine invented as yet by the art of man.

"No reflecting mind can avoid recognising in its perfection, and regarding with reverential awe, the Divine skill that has constructed it."

A SUCCESSFUL treatment for snake bite is recorded from the Rio Grande. Two horses were bitten by the same rattlesnake. A few hours afterwards the submaxillary, parotid, and all glands situated about the head and neck were greatly enlarged; from the nostrils and gums, a clear mucous discharge ran down; the eyes were glairy, with the pupils greatly dilated, and the coat was rough and staring. To each animal Dr. Bell gave half-a-pint of whisky, with a little water, and half an ounce of ammonia, while the wounds were fomented with a strong infusion of tobacco, and afterwards poulticed with chopped tobacco leaves. Both horses recovered.

"In furtherance of natural science work at Eton, an excellent telescope has been recently given to the school by the energy and liberality of some of the masters." Mr. H G. Madan describes the instrument, a refractor of 5·9 in. clear aperture and 88 in. focus, made and erected by Messrs. Cooke and Sons, of York; it was equipped with a battery of eyepieces, of powers ranging from 30 to 400, and with a bifilar micrometer.

THE trigonometrical survey of England and Wales, on the scale of one inch to a mile, has been completed during the past week. It was commenced in the year 1791.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned

LECTURER in the Electrical Engineering Department—S C Laws, Northampton Polytechnic, St John Street, E.C.1 (January 8).

A DIRECTOR OF STUDIES for British Institute, Rome—The British Council, 3 Hanover Street, W.1 (quoting 'Italy') (January 13).

CIVILIAN SURVEYORS OF WORKS for the Military Engineer Services, India—The Military Department, India Office, S W 1 (marked 'Surveyors Recruitment') (January 15)

ASSISTANT HEADMASTER (later to become Headmaster) for the Mackay School, Valparaiso, Chile—The British Council 3 Hanover Street, W 1 (quoting 'Chile') (January 20)

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S 2.B (Met), Department Q.A , Air Ministry, Adastral House, Kingsway, W C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Amgueddfa Genedlaethol Cymru National Museum of Wales. Thirty-second Annual Report, 1938–39. Pp 53. (Cardiff: National Museum of Wales) [1312

North of Scotland College of Agriculture Report on the Work of the North of Scotland College for the Year 1938–39 Pp 32. (Aberdeen North of Scotland College of Agriculture.) [1412

British Empire Cancer Campaign. Sixteenth Annual Report of the Grand Council Edited by J. P Lockhart-Mummery Pp x+370 (London. British Empire Cancer Campaign) [1512

Memoirs of the Cotton Research Station, Trinidad Series B Physiology, No 12 · Further Studies on Transport in the Cotton Plant vii Simultaneous Changes in the Production and Distribution of Dry Matter under varying Potassium Supply By E Phillis and T G Mason. Pp 889-900 (London: Empire Cotton Growing Corporation) 2s. 6d. [1812

Ministry of Health The Control of Puerperal Sepsis. (Memo 226, Med) Pp. 10 (London H M Stationery Office.) 2d net. [1912

London School of Hygiene and Tropical Medicine (University of London) incorporating the Ross Institute Report on the Work of the School for the Year 1938–39 Pp xviii+98 (London London School of Hygiene and Tropical Medicine) [2112

Colonial Office Higher Education in Malaya Report of the Commission appointed by the Secretary of State for the Colonies, June 1939 (Colonial No. 173) Pp vii+151 (London H M Stationery Office) 2s 6d net [2712

Other Countries

The Cooper Union for the Advancement of Science and Art Eightieth Annual Report, for the Year ending June 30, 1939 Pp 122 (New York, Cooper Union for the Advancement of Science and Art) [712

Nigeria. Annual Report on the Forest Administration of Nigeria for the Year 1938. Pp 14 (Lagos Government Printer, London Crown Agents for the Colonies) 1s. 6d [1112

Norges Svalbard- og Ishavs-undersøkelser Meddelelse Nr. 42 Crossing West Spitsbergen from South to North. By Stanislaw Siedlecki Pp 14 Meddelelse Nr 43 Some Pelecypods from Franz Josef Land, Victoriaøya and Hopen collected on the Norwegian Scientific Expedition 1930 By T. Soot-Ryen. Pp 22+1 plate. Meddelelse Nr 44 A Small Contribution to the Lichen Flora of the Eastern Svalbard Islands—Lichens collected by Olaf Hanssen in 1930. By B. Lynge Pp 12 Meddelelse Nr 45 · Recent Norwegian Expeditions to South-East Greenland By Gunnar Horn Pp 10. Meddelelse Nr 46 · The Settlements and Huts of Svalbard By Anders K Orvin Pp. 14 Skrifter om Svalbard og Ishavet, Nr 76 Lichens from Jan Mayen collected on Norwegian Expeditions in 1929 and 1930 By B Lynge. Pp 56+2 plates 4 50 kr Skrifter om Svalbard og Ishavet, Nr. 77 Das Festungsprofil auf Spitzbergen, 5 · Stratigraphie und Invertebraten-fauna der älteren Eotrias Von Hans Frebold. Pp. 58+3 plates 5 00 kr. (Oslo Norges Svalbard- og Ishavs-undersøkelser) [1112

Memoirs of the India Meteorological Department. Vol 27, Part 2. Discussion of Results of Sounding Balloon Ascents at Madras in the Months of June to November during 1932–1935 By N. K. Sur and K. P. Ramakrishnan. Pp 29–44+3 plates (Delhi: Manager of Publications) 14 annas; 1s. 3d [1212

Publications of the Observatory of the University of Michigan. Vol 8, No. 1 A Study of the Spectrum of VV Cephei. By Victor Goedicke. Pp. 36+4 plates (Ann Arbor, Mich.: University of Michigan) [1312

Proceedings of the United States National Museum. Vol. 87, No. 3073 Observations on the Birds of Northern Venezuela. By Alexander Wetmore. Pp 173–260. (Washington, D C.: Government Printing Office.) [1312

U S. Department of Agriculture. Leaflet No. 189: Psocids, Annoying House Pests. By E. A Back. Pp. 4. (Washington, D.C.: Government Printing Office.) 5 cents. [1312

Bulletin of the American Museum of Natural History. Vol. 76, Article 7: A Revision of the Typical Crab-Spiders (*Misumeninae*) of America North of Mexico. By W. J. Gertsch. Pp. 277–442. (New York. American Museum of Natural History.) [1312

Annales Bryologici a Year-Book devoted to the Study of Mosses and Hepatics. Edited by Fr. Verdoorn. Vol. 12 (1939). Pp. vi+164 (Leiden: Chronica Botanica Co.; London: William Dawson and Sons, Ltd.) 6 guilders. [1312

U S. Department of the Interior Office of Education Bulletin, 1939, No 3: High Educational Institutions in the Scheme of State Government. By John H. McNeely. Pp v+108. 15 cents. Bulletin, 1939, No 6 Education in Yugoslavia. By Severin K. Turosienski Pp. vii+146 25 cents (Washington, D.C.. Government Printing Office.) [1812

Advisory Committee on Education. Staff Study No. 3 State Personnel Administration, with Special Reference to Departments of Education By Katherine A Frederic. Pp xiv+270 (Washington, D C. Government Printing Office.) 35 cents. [1812

Canada · Department of Mines and Resources · Mines and Geology Branch, Bureau of Mines. The Mining Laws of Canada · a Digest of Dominion and Provincial Laws affecting Mining. Compiled by Arthur Buisson (No. 795) Revised edition. Pp. vii+110. (Ottawa King's Printer) 25 cents. [1812

Colony of Mauritius · Department of Agriculture Ninth Annual Report of the Sugarcane Research Station for the Year 1938. Pp. 66 85 cents. Sugarcane Research Station, Bulletin No. 16 A Botanical and Agricultural Description of some Sugarcane Varieties raised by the Sugarcane Research Station, Mauritius By Dr. H Evans and G C. Stevenson. Pp v+10+5 plates. 45 cents (Port Louis. Government Printer) [1812

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland Bd. 78, Nr 5 · The Godthaab Expedition 1928—A Theoretical Treatment of the Hydrographical Observation Material By Alf B Killerich. Pp 150+14 plates 8.50 kr. Bd. 105, Nr 4 The Scoresby Sound Committee's Second East Greenland Expedition in 1932 to King Christian IX's Land—The British East Greenland Expedition 1935–36 Geological Investigations in East Greenland, Part 3: The Petrology of the Skaergaard Intrusion, Kangerdlugssuaq, East Greenland. By L R. Wager and W. A. Deer. Pp 352+27 plates 20.00 kr. Bd 119, Nr. 10 A Revised Index of the Insects of Grønland, containing a Supplement to the Insect List in Kai L Henriksen and Will. Lundbeck Grønlands Landarthropoder (Medd om Grønl., Bd 22, 1918) By Kai L Henriksen. Pp 112 5.00 kr. Bd 120. Poul og Niels Egede · Continuation af Hans Egedes Relationer fra Grønland samt Niels Egede Beskrivelse over Grønland Ved H. Ostermann Pp. xi+380. 18.00 kr Bd. 125, Nr 1 An Annotated List of the Fishes collected on the Several Expeditions to Greenland, the Fox Basin Region, and the Coast of Labrador, by Capt R. A Bartlett, from 1925 to 1935 By Samuel F Hildebrand. Pp 12. 0.50 kr Bd 125, Nr. 2: The Greenland Variety of *Theromyzon garjaewi* (Livanow). By S A. Boisen Bennike Pp 8 0.35 kr Bd. 125, Nr. 3. Contributions to the Glaciology of North-West Greenland By J. W. Wright. Pp. 44+6 plates 2 50 kr. Bd 125, Nr 4. i. Studies on the Embryology and Cytology of Saxifraga By L. Harmsen Pp 16 0 75 kr. Bd. 125, Nr 5 Toxin in the Flesh of the Greenland Shark. (Communication from Upernavik and the University Zoophysical Laboratory at Copenhagen) By Ove Bøje. Pp 16 0 75 kr. (København C. A. Reitzels Forlag) [1812

League of Nations Advisory Committee on Social Questions. Enquiry into Measures of Rehabilitation of Prostitutes (Part 3 and Part 4) Methods of Rehabilitation of Adult Prostitutes, Conclusions and Recommendations (Official No.: C. 83. M. 43 1939 IV.) Pp. 157. (Geneva League of Nations; London George Allen and Unwin, Ltd) 3s. 6d [1812

Tanganyika Territory. Department of Agriculture Annual Report 1938 Pp 62 3s. Pamphlet No. 25 Sisal Experimental Station Report for the Year 1938. Pp 24 50 cents; 6d (Dar es Salaam. Government Printer) [1912

Ministry of Public Works, Egypt Physical Department Paper No. 39 Report on the Measurement of the Quantity of Dust in the Atmosphere of Cotton Ginneries By H E. Hurst and P. A Curry. Pp. 14. (Cairo: Government Press) P.T. 5; 1s. [2012

Indian Forest Records (New Series). Entomology, Vol 6, No. 1 New Indian Cerambycidae. By J C. M. Gardner Pp. 14. (Delhi: Manager of Publications.) 6 annas, 7d [2012

Annual Report of the Agricultural Meteorology Section, India Meteorological Department, for the Year 1937–38. Pp. 50+6 plates. (Delhi Manager of Publications) [2012

India Meteorological Department Scientific Notes, Vol. 8, No. 83. On the Forecasting of Rain over South Bengal during the Nor'wester Season, mid-March to mid-May. By A. K. Roy. Pp. 8. (Delhi; Manager of Publications.) 5 annas; 6d. [2012

Observatoire de Zi-Ka-Wei Annales de l'Observatoire astronomique de Zô-Sè (Chine). Tome 21, Fasc 2: Tables des petites planètes 149, 270, 317, 345 Par le P. E. de la Villemarqué. Pp. 46. Tome 21, Fasc. 3 · Positions photographiques d'Eros (1930–1931) et (O—C) conclus. Par le P E. de la Villemarqué. Pp. 20. Tome 22, Fasc. 1 Le pendule élastique inversé, son application au nivellement des instruments astronomiques; quelques essais. Par le P. M. Burgaud Pp. ii+28+7 plates. Notes de Météorologie physique, Fasc. 9 · Étude de la vapeur d'eau, de l'oxygène et des poussières contenues dans l'atmosphère à l'Observatoire de Zô-Sè. Par le R. P. Pierre Lejay. Pp. ii+67. (Zi-Ka-Wei. Observatoire de Zi-Ka-Wei.) [2012

U S. Department of the Interior: Office of Education. Bulletin 1939, No. 10. The Graduate School in American Democracy. By Isaiah Bowman. Pp. ix+70. (Washington, D.C.: Government Printing Office.) 15 cents. [2112

League of Nations. Report on the Work of the League (continuation) July–mid-November 1939 (Official No.: A. 6 (a). 1939.) Pp. 62. (Geneva. League of Nations; London; George Allen and Unwin, Ltd.) 1s. 6d. [2112

Anthropological Records. Vol. 1, No. 7: Culture Element Distributions, 11: Tribes Surveyed. By A. L. Kroeber. Pp. 435–440. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 25 cents; 1s. 6d. net. [2712

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LIBRARY

UTILIZATION OF SCIENTIFIC MAN-POWER

THE concern which has recently found expression as to the position of science in the war effort of Great Britain, and the extent to which the services of scientific workers are being utilized, is evidence that the importance of this contribution is recognized far beyond the ranks of scientific workers themselves. The apparent tardiness with which the maximum contribution of science is being developed in the war-time effort of Great Britain has caused much questioning, and it is to be hoped that the activities of the newly appointed Advisory Council on Scientific Research and Technical Development will quickly overcome at least some of the obstacles which have appeared.

Political and Economic Planning (P E P) published a year ago an admirable broadsheet on "Man-Power Policy" in which four principles were laid down as essential and suggestions made for giving effect to them It has now published a review of the present situation and its relation to economic policy under the title "Industrial Man-Power", in which the effect of expansion and contraction in industry in war-time is considered The table showing the changes which have occurred in certain industries between 1923 and 1938 in Great Britain and Northern Ireland suggests that the great 'dilution' problem of the War of 1914–18 may be of much less importance to-day, since there now exists a range of metal trades already staffed for munitions, without the need to create them afresh.

This factor particularly affects the position of women, and it is accordingly unlikely, in view of the work already carried out under the Industrial Health Research Board and the National Institute of Industrial Psychology, that the grave social problems arising out of physical difficulties through the industrial employment of women will recur The chief reason for alarm indeed appears to lie in the tendency of the Government to dispense with the Factories Act The recent report of the Industrial Health Research Board recalls that its work was born of the experience of the War of 1914–18, but there are signs that scientific workers must bestir themselves if that entirely new attitude towards the study of working conditions and industrial welfare is to be preserved under the stress of the present war

In industry as in civil defence, there is already evidence that the over-working of men and women has begun, and there are no signs of a consistent and well-understood policy in granting permission to work overtime Equally it is important to conserve our limited resources of skilled labour by training, on a sufficient scale, fresh recruits for the less skilled operations A scientific policy, which will keep alive the protective machinery and handle such problems before they become serious enough to damage health and efficiency, demands the co-operation of scientific workers as much as the prosecution of fresh research in these fields.

The difficulties experienced at the moment, however, are chiefly of a special and local character. There is some difficulty in spreading the available skilled workers evenly over the field, especially among the new munitions and aircraft factories Social difficulties also attend the provision of the non-factory groups with work in munition factories The dangers and opportunities in bringing many of these unorganized workers into official organizations are immense. Again, the labour requirements of several large industries, such as the textile groups, depend very much on policy, particularly export policy, and for this reason lack of a clear

economic policy on the part of the Government is being held responsible for the rise in unemployment.

The P E P broadsheet forecasts a considerable scarcity of male labour in the coal-mining, shipbuilding and other heavy industries, rather than in the munitions industries, and stresses the fundamental changes in the whole structure of British society since the War of 1914-18 in relation to the industrial sources of man-power for the forces. A much greater proportion of the population is engaged in selling goods or performing personal services, and the entire non-factory working-class is larger in relation to the rest of the population. Of the non-factory groups, a much larger proportion are now employees rather than employers or workers on their own account. The distributive trades, personal services, and other non-factory trades and occupations are regarded as important sources of personnel for the fighting services and civil defence.

The change in the framework of labour relations involves, for a thorough study of the man-power problem, a survey of the changes in organization, and the broadsheet comments on the great "civil service" which has grown up in industry, represented by thousands of paid officials, hundreds of joint committees and slow-moving democratic machinery Smooth adaptation of labour relations to war problems as they arise will depend on whether such constitutions reveal latent elasticity or become too brittle to bear the strain.

The value of the National Register as a basis for the scientific use of man-power does not require stressing here. The P E P broadsheet refers particularly to the Central Register of scientific, technical, professional or higher administrative workers, which is already being used by Government Departments and by firms engaged on work of national importance. Much unemployment still exists, however, among highly trained technical workers, particularly graduates in chemistry and other sciences, and even among professional workers such as architects, whose services would be expected to be in demand in numerous problems involved in civil defence and evacuation A special section of the Central Register has been formed of those in this position, but the preservation of their abilities would seem to require a considerable extension of research programmes, even if such activity has no immediate connexion with war. So far as chemists are concerned, the establishment by the Chemical Society of an Advisory Research Council already provides a means for pooling suggestions for research and bringing them before those engaged in research in the universities and colleges.

Something more is required than improvements in placing methods. Formulation of a really adequate programme of work and its adoption by the Government could scarcely fail to secure the efficient and adequate use of the available scientific personnel and the disappearance of unemployment from the scientific register.

Certain suggestions were made by Sir William Bragg in his presidential address at the anniversary meeting of the Royal Society (see NATURE, Dec. 9, 1939, p. 953). Sir William Bragg suggested that a Ministry of Science would be too formal and rigid for immediate needs and that personal and elastic methods of using knowledge were the most successful We might well be content to bring science as a whole into close relation with government as a whole by attaching a central authority of science to the central authority of the country. The immediate application of science in any department of national affairs should be made from within that department, not from without, and the real need is for means of ensuring that the Government is able to rely on and make use of the whole range of scientific knowledge

The value of the Royal Society as a consultative body, so strongly urged by Sir William Bragg, will be endorsed by all scientific workers, most of whom will agree that the Government could well utilize these services much more widely and fully. It is, however, the evidence of a bureaucratic outlook, indicated by the interruption of important research as a result of evacuation or other exigencies and the neglect to provide alternative accommodation, that has occasioned misgivings in the minds of scientific workers. The Advisory Research Council of the Chemical Society appears to be the first organized attempt to mobilize the research resources of the country at the universities or elsewhere, and it may be hoped that the new Advisory Council will extend the process quickly and effectively.

In the meantime scientific workers might well follow the lead of Prof. J. D. Bernal, who at the recent annual council meeting of the Association of Scientific Workers alluded to a number of scientific problems which would appear to have been overlooked in the present situation. Suggestions for investigation should not be restricted to any one field. Prof. Bernal himself referred to

the need for a scientific study of 'black-out' psychology and the effects of the 'black-out' on the temperament of the community Similarly, problems of health and hygiene raised by evacuation and other changes await investigation

Besides the suggestion and initiation of lines of investigation, the maximum development of our scientific effort in war demands an immense educational effort, and whatever central body is established will require to have under careful consideration the propaganda of science Science cannot be used to the best advantage without the co-operation of the whole public The stimulation of public interest in science is of vital importance to public efficiency and technical morale, and incidentally should provide a check on the bureaucratic tendencies which have been causing concern in some quarters.

The educational aspect is of importance from another point of view also There is perhaps the danger that in the mobilization of scientific effort and resources in support of our cause, there may be further disposition to blame science for some of the evils of war Propaganda of the type we have indicated should do more than prevent such misunderstanding. By promoting that full understanding and sympathy which are essential in the highest technical achievements, they should also prepare the way for science to make its full contribution, undisturbed by the demands of war, to the advancement of knowledge and the enrichment of human living

VICTORIAN SOCIALISM

The New World Order
Whether it is Attainable, How it can be Attained, and What Sort of World a World at Peace will have to be By H G Wells Pp 192 (London · Martin Secker and Warburg, Ltd , 1940) 6s net

"FEW human beings," says Mr Wells in his new book, "are able to change their primary ideas after the middle thirties They get fixed in them and drive before them no more intelligently than animals before their innate impulses " Here he does himself a great injustice We used to wonder what panacea he would discover next. He was sure to advocate it in a brilliant and stimulating manner.

But the time comes to all of us—it came to me long ago—when our minds stiffen, and we become, as a Frenchman unkindly said, the comedians of our early convictions The hardships of his early life have permanently embittered Mr Wells against the class in which his genius has placed him He sees Red when he thinks of them, and exults in the destitution which he hopes awaits them

So, since he is far too well-informed to be a Bolshevik, he has nailed his colours to that water-logged derelict, Fabian collectivism. We have only to make a clean sweep of emulation, ambition, love of private ownership, patriotism and pugnacity, and we shall all be as happy, progressive and intelligent as a flock of sheep. That is always the way with Utopians Abolish all the strongest passions and instincts of human nature, and a terminal state of blessedness, an earthly paradise, will be reached.

It is pathetic to look at the row of deserted idols which we used to worship in the last century Liberalism, Democracy, Human Perfectibility, Socialism, Communism -there are few any more to do them reverence Liberalism, which might sweep the suburbs with the Gladstonian creed of peace and retrenchment, is content to limp feebly after Labour, and has paid the penalty Democracy is still a fetish in America, where it means anything, from an attribute of the Deity to a method of therapeutics, except what it really is, a not very successful experiment in government "Uric acid," I read in a New York medical journal, "is tottering on its throne The triumphs of Democracy are not confined to politics " Elsewhere it is merely accepted from inertia, or from fear of something worse. No institution has lost in prestige so much as the House of Commons Who now reads the dreary debates, which are not expected to turn a single vote ? (Democracy as a form of society—equality of consideration—is a different matter , some other name ought to be found for it) As for human perfectibility, nobody any longer believes in a law of progress The fact of progress in the past—for example, in the eighteenth and nineteenth centuries—cannot be denied. But in the future ? We began with faith, we went on with hope ; now there is nothing left but charity.

Socialism has never recovered from giving birth to its misbegotten brat Communism There was such a thing as Social Democracy, though Socialism and Democracy are fundamentally incompatible Nothing could be more ignominious than the total collapse of the Social Democrats in Italy and

Germany at the first impact of Fascism. The Bolsheviks found that the Social Democrats had not got the true milk of the word, and helped in their overthrow. Mussolini and Hitler were quick to observe the signs of the times

Communism is also practically dead It exists in the U S S R only for export, the Government of the Soviet Republic is pure Fascism or State capitalism It would be difficult to name any prediction of Marx that has not been falsified by history; but the most significant of all his miscalculations was that after the success of the social revolution the State would "wither away" Instead of withering away, the State in Russia is omnipotent, the most brutal and searching tyranny that the world has ever known Communism at home is now the creed of a few *enragés* and armchair doctrinaires, and of callow boys and girls at Oxford, Cambridge and the London School of Economics

The total failure of the prophecy that the State under Soviet Socialism would wither away is important because it affects other kinds of socialism The inevitable result of collectivism is to deprive the citizen of all liberty, and to put him at the mercy of a horde of ignorant, indolent and insolent Jacks-in-office, who take their orders from above This is the crucial difference between State-socialism and democracy The bureaucracy under socialism must take their orders from above Mr Wells wishes his citizens to be free to speak their minds, but your bureaucrat cannot stand criticism, and will know well enough how to gag it. Mr Wells's Gestapo are to be "sturdy and assertive" There is no fear of their being anything else

State-capitalism can make out a plausible case for itself But apart from the difficulty of finding skilled administrators who are willing to give their best for a very small salary (in the U.S S.R differential salaries are as steeply graded as in England) in the absence of competition it is most unlikely that the infinitely complicated affairs of a great industrial community would be competently handled by State officials Such experience as is available is very discouraging to the advocates of that favourite Fabian slogan, 'a planned economy'

I entirely agree with Mr Wells's detestation of the new idol which has dethroned the fetishes of the Victorians--frenzied nationalism The deification of the State is indeed a monstrous and Satanic form of idolatry It is at present the strongest force in the world, though it must be said to the credit of the democratic countries that it has made few converts in England, France or the United States It unfortunately commands the allegiance of some of the best as well as the worst elements in the totalitarian countries, and is therefore the greatest danger that European civilization has ever had to meet. Nevertheless, to speak of the possible "extinction of mankind" (p. 18) is surely a violent exaggeration The worst that can happen to Europe, if we persist in what are really civil wars, waged with greater fury than the old wars of religion, is that we may be plunged into another 'dark age', which we may hope would not last six hundred years, like the welter of barbarism which followed the downfall of Græco-Roman civilization But America and the British Dominions would survive and hand down the torch. Count Keyserling, in his "Révolution Mondiale", unaccountably forgot the not unimportant part of the human race who speak English For I do not think that even Great Britain will either cease to exist or relapse into savagery

I also agree with the author about the ruinous folly of the present war, but perhaps at present the less said the better on that subject.

One protest I must make in conclusion I am not supposed to be very fond of the Roman Catholic Church, but I deprecate Mr Wells's very harsh words about that institution Catholicism is certainly anti-revolutionary With its unequalled experience of human nature, that Church knows that revolutions always lead to reactions, and achieve very little at a terrible cost of human suffering But it preserves some valuable traditions which are in some danger of being lost, including a philosophy which is far superior to modern systems. I am specially distressed to read what Mr Wells says about Spain I cannot understand how any decent person can deny that the Nationalists were justified in taking arms against those devils in human shape, the Spanish Reds, who, fighting under the 'hammer and sickle', and under orders from Moscow, butchered three hundred thousand men and women, a hundred thousand in Madrid alone, in an attempt to extirpate whole classes of the population It is difficult to forget what an American eye-witness saw in the town of Ronda, near Malaga The Reds impaled on stakes all the male inhabitants who belonged to the middle class, and while they were dying in agony compelled them to watch their wives and daughters being first violated and then burnt alive There are scores of similar horrors equally well authenticated

Although Mr Wells's Utopia seems to me utterly unrealizable, no one can read the book without admiration for his earnest longing for a new and better world As Plato said of his Republic, the type of the perfect State is laid up in heaven, and we need not inquire too curiously whether it is likely to be realized on earth The obstacles are human sin and folly, and we shall soon have sharp enough lessons to cure all but the incurable.

W R. INGE

TERRESTRIAL MAGNETISM AND ELECTRICITY

Physics of the Earth, 8:
Terrestrial Magnetism and Electricity
Edited by J. A. Fleming. Contributors: J. Bartels, L. V. Berkner, J. A. Fleming, O. H. Gish, H. D. Harradon, C. A. Heiland, E. O. Hulburt, H. F. Johnston, H. E. McComb, A. G. McNish, W. J. Rooney, B. F. J. Schonland, O. W. Torreson, L. Vegard. Pp. xii + 794. (New York and London: McGraw-Hill Book Company, Inc., 1939.) 52*s.* 6*d.*

INTEREST in geophysics is widespread in the United States of America to a degree paralleled nowhere else. This still young community, now in the first flush of vigorous scientific maturity, is from practical motives actively exploring the hidden riches of its land; it is also energetically studying the land, the sea, and the air, from purely intellectual motives. One consequence is that America possesses, in the American Geophysical Union, the largest geophysical society in the world; this Union publishes an extensive and many-sided annual report, but not, as yet, any general geophysical journal. America is, however, the home of the only existing journal devoted solely to terrestrial magnetism and electricity, and the only research institution which pursues all branches of this department of geophysics, from a world-wide point of view, is also American. It is therefore fitting that the volume under review, which is probably the largest general work ever published on the subject, should come to us from across the Atlantic. It will give a valuable stimulus and help to the study of the earth's magnetism and electricity, publications on which have hitherto been rather inaccessible to workers in other fields. The volume is one of a series of reports on geophysics prepared under the auspices of the U.S. National Research Council, with which the American Geophysical Union is associated.

The book is not a systematic treatise on its subject (and there remains a need for such a treatise); it is a collective work by fourteen authors, under the editorship of Dr. J. A. Fleming, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington —who himself, in the first chapter, on "The Earth's Magnetism and Magnetic Surveys", gives a general introduction to this, the larger of the two subjects with which the book deals. These two subjects are in fact not very intimately related to one another, and the four 'electrical' chapters—on "Atmospheric Electricity" (iv, Gish), "Instruments used in Observations of Atmospheric Electricity" (v, Torreson), "Earth-Currents" (vi, Rooney), and "Thunder-clouds, Shower-clouds and their Electrical Effects" (xii, Schonland)—might well have appeared as a separate volume; these chapters are excellently written in a systematic expository style, and almost constitute a treatise on terrestrial electricity, though of course this subject offers scope for a more detailed treatment. With their bibliography, these four chapters occupy about a quarter of the book.

No fewer than a hundred pages are devoted to a bibliographical chapter (xiii, Harradon); this is a valuable part of the book, because one of the difficulties in this, as in some other branches of geophysics, is that the original data and observations are for the most part not published in the scientific journals which have wide currency throughout the world; often they appear in separate publications or in observatory reports—the introductions or appendixes of which sometimes contain important discussions of the data, not to be found elsewhere. Moreover, owing to the border-line character of the subject (lying as it does between physics, astronomy, meteorology, geology and geography), together with the fact that there is only one journal expressly devoted to it, its current literature is scattered over an exceptionally wide collection of periodicals. Hence such a bibliography forms, as the editor states, "a most valuable research tool".

The remaining two thirds of the book includes two main groups of chapters, much more closely linked together than might appear at first sight. There are the more strictly magnetic chapters, including (with the first, already mentioned), "Magnetic Instruments" (ii, Johnston, Fleming and McComb), "Magnetic Prospecting" (iii, Heiland), "On Causes of the Earth's Magnetism and its Changes" (vii, McNish) and "Some Problems of Terrestrial Magnetism and Electricity" (viii, Bartels); and there are three chapters relating to the upper atmosphere, including one with that title (x, Hulburt), one on "Radio Exploration of the Earth's Outer Atmosphere" (ix, Berkner), and one on the "Aurora Polaris and the Upper Atmosphere" (xi, Vegard).

Workers on the many topics with which the book deals will recognize the authority of the writers who contribute the several chapters. With the exception of Chapter iii, the outlook of the book is more towards the purely scientific than the important practical aspects of the subject; it

may be said to be directed to the initiation or enlightenment of physicists (and perhaps also astrophysicists) in one of the oldest of the modern sciences, which still confronts us with the mystery of Gilbert's great discovery that the earth is itself a magnet, and the but little less mysterious secular variation of the magnetic field Apart from this, the exciting and complex problems of the subject are concerned mainly with the atmosphere, there is the semi-meteorological problem of the maintenance of the earth's negative surface charge, and the group of problems associated with the action of the sun upon the earth—for it is the sun which causes and controls the inconstant daily magnetic variation, the irregularly occurring magnetic storms and the associated auroras, and also the recently discovered group of terrestrial phenomena linked with eruptions in the solar chromosphere—radio fading and brief magnetic disturbances The moon also, through the lunar tide which it produces in our atmosphere, plays a small but interesting part in causing the magnetic variations.

All these subjects are discussed in an interesting and authoritative way in this book, and if the voices are not always in unison, this is but a token of the need for more observation and more thought to illuminate dark questions. It is to be hoped and expected that many among the readers of this book will be led to take a share in making these "rough places plain"

S. CHAPMAN.

THE SOYA BEAN

Le soja et les industries du soja

Produits alimentaires, huile de soja, lécithine végétale, caséine végétale Par A Matagrin Pp. x + 390. (Paris. Gauthier-Villars, 1939.) 60 francs

IT is well known that the soya bean (*Glycine soja*) is one of the most valuable of cultivated crops, and this comprehensive account is of value, particularly at the present crisis, because of the numerous by-products that are obtainable from this particular plant It is in fact one of the world's indispensable commodities

The author records with considerable success the whole range from the cultivation of the bean to the manufacture of the latest form of by-product. In an account of the history and origin of the crop, it is pointed out that the home of the plant is eastern Asia, and in particular, Manchuria, Japan and China, from which regions, for many years, the main supply for the markets of the world was obtained. It is natural that other countries, with an eye to the valuable nature of the crop, should have endeavoured to establish it into their agricultural systems, and the most successful so far has been the United States. Here after years of trial and experiment, success has been attained in breeding types suitable to the climatic conditions, and the output of which now rivals in extent that of the Far East In the detailed account that is given of the many attempts that have been made to establish the crop, it is noted that although the crop is stated to be adaptable and capable of growing from the equator to 50° S and 60° N. respectively, yet success has, in the main, only been achieved on a grand scale in those countries possessing a temperate or subtropical climate

In view of its great nutritive value, due to its high oil and protein content, there is little doubt that if the crop could be established in the tropics it would be of great value, not only because it is a valuable export crop which could be sold for cash and would, therefore, widen this field, which is so often held by cotton alone at present, but also on account of its food value To the many who are now interested in the nutrition drive that is taking place in the British colonies its value is obvious; but it is not an easy crop to grow in the tropics. The number of varieties as indicated by the author is very great, but he brings out clearly that each variety has been evolved to meet particular types of soil and climatic conditions, and that each will usually only be found in a comparatively circumscribed area where it can enjoy these particular conditions.

The United States introduced numerous varieties and undertook prolonged selection before types suitable to American conditions were obtained The trade demands a large round bean of a white or light colour, but unfortunately such experiments as have been made in the tropics indicate that the type of soya that grows best is one of a darker colour with a smaller and flatter bean There is no doubt that much plant-breeding work will be needed before types really suited to the tropics can be evolved, although there is evidence that success will ultimately be obtained Another difficulty is the short viability of the seed under tropical conditions. For this reason it is not always easy to obtain an even stand, with the result that disappointing crops are often reaped,

although individual plants may often be excellent heavy bearers. The causes of this rapid loss in viability will, therefore, need to be studied and systems of storage, within the means of the peasant, evolved. Temperature is one contributing factor, as seed stored at about 60° F. keeps its viability well. It is probable that moisture content may be another factor as a natural corollary.

Another difficulty that will have to be faced is ignorance of the most attractive ways to prepare it for human consumption. Not the least valuable part of this book is the account given by the author of the different dishes that are prepared in various countries, and a campaign to educate the grower into the cooking of the bean will probably have to accompany any attempt to introduce it into his cropping system The problem of inoculating the seed will also need to be faced, as it appears obvious that good crops cannot usually be obtained unless the right inoculum is present This problem should not be difficult of solution, however, once a commencement has been made, as soil from an inoculated field can be used to extend the system

Nearly half the book is devoted to accounts of the commercial products of the bean, particular attention being paid to the processes involved in the refining of the oil and its numerous uses, to the preparation of lecithin and the manufacture of vegetable casein, the demand for which has expanded greatly in recent years

The volume is well arranged, but it is hoped that in a future edition an index will be added

G. EVANS

MYTHS AND MAGIC IN JAMAICA AND HAITI

Voodoo Gods

An Inquiry into Native Myths and Magic in Jamaica and Haiti. By Zora Hurston Pp x+290+24 plates (London. J. M. Dent and Sons, Ltd, 1939.) 15s. net.

OBEAH in Jamaica and Voodoo in Haiti, as secret cults of the Negro, have both aroused considerable curiosity, mostly morbid The literature relating to them is extensive, but more remarkable for its sensational statements than its ability to carry conviction as to its truth or accuracy of observation. It is, in fact, with a few notable exceptions, based on hearsay Miss Hurston's knowledge of both cults has at least been acquired, to a great extent, at first hand; and her book is the work of a trained and experienced observer. As a member of the race she was qualified to take part in the ceremonial as an initiate, while as a pupil of Prof. Franz Boas she was able to grasp its significance as the manifestation of a form of religious belief, and view it with detachment.

Miss Hurston gives the two cults of Obeah and Voodoo their social setting in her accounts of the Negro community in Jamaica and of society and politics in the Black Republic of Haiti. The high lights of Haitian history are reached in revolution and massacre, more especially in the earlier years of the present century, leading up to occupation by the United States in 1915. The occupation lasted for nineteen years. Notwithstanding this story of bloodshed and corruption, the author sees in the recent growth of a young intelligentsia, which is making its mark in public life, the possibility of a future regeneration There are indications of the growth of a national consciousness and of a decrease in the degree of cultural dependence on France

In this movement towards cultural and national independence of white influence, it is thought by some, strangely enough, that Voodoo will play its part. This may seem surprising, in view of the fact that it has been usual to look upon Voodoo solely as an influence for evil, rather than as a form of spiritual belief, which could hold its own in the long run against one of the more highly organized religions, such as Christianity. This may be due to prejudice, and it has to be conceded that under the influence of the negro temperament, even Christianity itself may assume strange forms. At the same time the popular and darker view of Voodoo may not be entirely accurate.

Miss Hurston attributes much of the sensationalism which has become almost inseparable from accounts of Voodoo to a failure to understand its symbolism. Thus she maintains that the reverence accorded to the gods of the Negro in the guise of the Roman Catholic saints 'done over in black', the prominence of the snake in their cults, the erotic rites and the magical dances, and the like, are all parts of an elaborate system of symbolism, which has been, but should not be, taken at face value. Voodoo, in fact, is neither snake worship nor magic mixed up with fetichism, sacrifice and other of the more repulsive erotic and necrophilic practices of wizardry, but an organized body of pagan belief with an African pantheon.

The gods of the Haitian pantheon to a great extent are localized, and a spirit of great power

in its own home may be unknown beyond a radius of fifty miles. Nevertheless some of the gods are reverenced generally, Damballa, for example, whose signature is the snake, and the goddess of love, whose position in relation to Voodoo as a fertility cult is indicated not only by the fact that she has no children, and is implacable to women, but also in that every man in Haiti is regarded as her husband It is significant that two types of gods or spirits are recognized—the Rada or Arada, who are the good gods, to whom only pigeons and chickens are sacrificed, and the Petro, the more powerful and evil gods, who can, however, be made to do good things. To them are offered pigs, goats, sheep, cows and dogs, and even on occasion dead bodies from the tombs. The Rada are said to have been brought with the Negroes from Guinea or Dahomey; the Rada came from the Congo.

This brief mention of one feature only in Voodoo belief does less than justice to a remarkable record, which will repay close study by those who wish to understand the mentality which underlies what has been the most remarkable experiment in self-government of the black races, on their own initiative, of modern times.

HABITS AND HABITATS OF TROUT

Trout Streams
Conditions that Determine their Productivity and Suggestions for Stream and Lake Management By Dr Paul R Needham Pp x + 233 (Ithaca, N.Y.: Comstock Publishing Co, Inc, 1938) 3 dollars.

THIS book is an attempt to place in the hands of anglers, sportsmen, and aquatic biologists, trustworthy information relating to trout and streams in which they live

The author is well qualified by years of experience to undertake such a work and has done it very well, not only using his own researches into stream problems but also that of many workers in his own country and in other lands where trout streams abound. The opening chapter deals largely with the various kinds of trout to be found in North America in both streams and lakes, dealing also with the habits of the different fish, followed by the chemical and physical conditions of trout streams in general and how such factors as temperature, transparency, oxygen content, and river bed play their part

The importance of biological indicators as evidences of pollution as against that of chemical analysis is stressed—a line which is advocated in Great Britain A very well illustrated chapter deals with trout stream animals which serve as food for trout, and should prove very useful to aquatic biologists, while it cannot fail to attract the angler with very little interest in stream organisms apart from fish The line drawings and photographs are very clear and the tables show evidence of much work in collecting the data.

An interesting point to which attention is directed is the large numbers of land insects which are taken by trout at certain times of the year; the probable reason for this is well discussed. A very large number of stomach contents have been examined to obtain the information, and so far as streams in the central area of New York State go, the author points out the amounts of foods fall in the following percentages: caddis flies, two-winged insects and may flies, 66 per cent taken in the order stated, beetles fourth (6·6 per cent of total), spring tails, leaf hoppers, ants, bees and wasps furnish 3–6 per cent of the total, with other foods about 1 per cent, made up of crayfish, shrimps, grasshoppers, stone flies, true bugs and earthworms.

The distribution of the food in streams is dealt with under the heading of the physical conditions of the bed of the stream, stream flow and depth. The methods to be adopted in taking a census of the stream animals is described and is much on the lines adopted by workers in other countries. Stocking, propagation, and protection find a place in the book, followed by the management of trout waters gained by experience in many States.

A very useful appendix deals with the numbers and sizes of fish it is wise to introduce into streams where restocking is done, taking into account size of stream and available natural foods. Outlines are given of stream surveys and how the information should be recorded to be of use for comparison with later surveys or with those of other rivers.

There is a very extensive bibliography, which should prove very useful to those seeking fuller information on the points dealt with. The book is very well illustrated with photographs of weir fishing pools and the like, making it very attractive to the non-technical reader as well as the scientific investigator. It also gives an insight into the extent of the investigations undertaken by workers across the sea, and being written by one who, in addition to being a scientific investigator is also an angler, links up the two sides of the questions that arise.

W. RUSHTON.

CHEMISTRY FOR INTERMEDIATE EXAMINATIONS

(1) General and Inorganic Chemistry
By Dr. P. J. Durrant Pp x + 547. (London, New York and Toronto · Longmans, Green and Co, Ltd, 1939) 8s

(2) A College Course of Inorganic Chemistry
By Prof J. R. Partington Pp. x + 658. (London. Macmillan and Co, Ltd, 1939.) 8s 6d.

(3) Intermediate Chemistry, Inorganic and Physical
By Dr. Frederick Prescott. Pp viii + 828. (London. University Tutorial Press, Ltd, 1939.) 12s. 6d

THE number of chemistry text-books is becoming greater every year, and because of their number, the final selection of a suitable book is becoming increasingly difficult During the last few years, the needs of those taking intermediate science examinations and university entrance scholarships have received special attention, and here are three new books catering for their requirements.

(1) Of the people who write text-books, the one who obtains the deepest insight into the student mind is not the teacher (who may, in fact, be very ignorant of its contents) but the examiner He, more than any other, is familiar with the facts which are absorbed, and the heresies which persist. Dr. P. J. Durrant is not without experience as an examiner, consequently something exceptional was to be expected, and expectation has not been disappointed The book he has written is an admirable one, and the reviewer can fully endorse the report of the publishers' reader that "the book has originality and vitality of presentation and gives a balanced and cultural appraisal of a difficult subject". Not only is this so, but the type, headings, spacing and arrangement of the text are excellent and make an immediate appeal to the eye

The outlook is modern, Bohr's theory of atomic structure and the electronic theory of valency are introduced at an early stage, and are used as a basis for the explanation of chemical theory. The scope of the book is not limited to the syllabus of any particular examination, and it would take the student through his first year at the university. The less common elements are omitted, and only compounds of definite technical or theoretical interest are included. The only important omission is a chapter on radioactivity, which might, with advantage, have been included. Errors are extremely rare: the quantum shells (p. 116) are presumably those of uranium, where the *P* shell contains 12 not 13 electrons, and *catronic* (p. 297) is an obvious misprint.

(2) Prof J R Partington's "Text-Book of Inorganic Chemistry" first appeared in 1921 and is now in its fifth edition. Successive editions have grown in size with the passing of time, until it is now too comprehensive for 'inter.-science' students His "College Course of Inorganic Chemistry" is intended to meet the needs of the latter, especially those rather older students who are beginners, as well as younger pupils

Although the plan and method of the "Text-Book" have naturally served as a foundation for the smaller work, much of the text has been rewritten and rearranged Nevertheless, the familiar and successful "Partington" method is obvious throughout The historical approach has been retained, special attention being given to the physical chemistry required at this stage, and although designed only as an intermediate text-book, it contains a very considerable amount of information and details of industrial processes

Opinions differ as to how soon the student should begin to use and appreciate the significance of electronic formulæ The modern tendency is to introduce them early and even to abandon the classical 'structural formulæ' entirely. The fact that here the former are sparingly used, and the latter largely retained, gives the book a somewhat old-fashioned appearance which might not entirely satisfy a modern teacher. This is the only criticism of the book, which well maintains the high "Partington" standard.

(3) Dr F Prescott's "Intermediate Chemistry" is described as "an entirely new book, a well-planned course of Inorganic and Physical Chemistry, based on modern ideas associated with the inter-related domains of Physics and Chemistry" The plan and balance of the book are good, but the contents are of very uneven quality, and the proof-reading has been entirely inadequate. A perusal of the book revealed twenty-one incorrect equations (and there may be more, for a systematic search was not made), many incorrect formulæ, and small errors in the text. All these mistakes are obvious and would be detected by the dullest student.

The section on the structure of the atomic nucleus and the occurrence of isotopes (pp. 252–4) contains the following sequence of statements: (*a*) the nucleus consists of protons, or particles of positive electricity, and, in most cases, electrons, the protons always being in excess; (*b*) the

atomic number corresponds to the net positive charge on the nucleus, (c) the mass number (atomic weight) is equal to the number of protons in the nucleus; (d) the difference between the mass number and the atomic number is attributed to neutrons in the nucleus; (e) neutrons are particles with a mass nearly that of a proton; (f) the neutrons, being of negligible mass, may be disregarded. The table (p. 253) which gives the atomic structure of a number of selected elements does not mention the neutron, which, considering its (apparently) uncertain properties, is perhaps just as well.

'Partington' and 'Durrant' are widely contrasting books, complementary rather than competitive Partington is historical, somewhat discursive, and (at least once) reminiscent (p. 433) Durrant is non-historical, logical, modern, and provides much tabulated information, of which Partington (p vii) disapproves. The teacher may choose according to his tastes J. N. SUGDEN.

BIOGEOGRAPHY IN THE U.S.S.R.

(1) Zoogeography
By I. I. Puzanov Pp. 360 + 32 (Moscow State Publication Office of the Commissariat for Education, 1938.) 7 80 roubles

(2) Zoogeography of the Ukrainian Socialist Soviet Republic
By M. Sharleman. Pp. 234 +1. (Kiev: Ukrainian Academy of Sciences, 1937) 6 60 roubles.

(3) Vegetation of the World
(Plant Geography, vol. 3.) By A P. Il'inskij Pp. 458. (Botanical Institute of the Academy of Sciences, Moscow-Leningrad, 1937.) 10 roubles

ALTHOUGH the three books referred to above by no means exhaust the most important biogeographical publications that have appeared in the Soviet Union during the last few years, they deserve special notice for various reasons.

(1) Prof Puzanov's book on zoogeography is of interest as an attempt to produce a text-book in this subject, which is still taught in too few universities, one of the reasons being the lack of suitable books for students A brief introduction dealing with the aims and methods of zoogeography and giving a concise history of the science is followed by two general parts. The first presents a lucid discussion of the ecological principles of zoogeography; the second deals with dynamics of faunas from a geological aspect. This difficult problem is dealt with in a very clear manner, without superfluous detail, while avoiding undue simplification. The third, and the main, part of the book is devoted to regional zoogeography, that is, to descriptions of the faunas of various regions. These descriptions are based mostly on vertebrate animals, but whenever possible some data on insects, etc., are also given. A feature of the book is the abundance of very well-executed (but poorly reproduced) original illustrations of numerous animals mentioned in the text. There are even three plates in colour, but their standard is low.

On the whole, the book undoubtedly represents a very successful approach to a university text-book of zoogeography, which is as yet lacking in any language, in spite of a seriously felt need for one.

(2) Sharleman's book on the zoogeography of the Ukraine is an original treatise on the regional distribution of vertebrates of that country in connexion with their ecology and geological history The book is written in the Ukrainian language, but Russian and English summaries are appended, while a complete list of species showing their distribution by districts, and a very full bibliography should make it very valuable for workers on the Palæarctic fauna.

(3) The book on the vegetation of the world by Il'inskij is published as the third (and concluding, but first published) volume of a series, the other two of which deal with plant geography and plant ecology respectively. The general part of the book is very brief—because the two other volumes just referred to should supply the introductory knowledge to the present one, which contains descriptions of types of vegetation by continents and natural regions. Most of the descriptions are clear, concise, based on up-to-date information and illustrated by well-reproduced photographs. All this goes to make a good text-book that should be very useful, particularly to geography students.

Indeed, it can be said that geography departments in Soviet universities are particularly fortunate in having modern text-books in both branches of biogeography, by Puzanov on animals and by Il'inskij on vegetation. The appearance of similar text-books in English would go a long way towards introducing biogeography into British and American universities, where this science is suffering from undeserved neglect. B. P. UVAROV.

MARGARINE

By PROF. J. C. DRUMMOND,
UNIVERSITY OF LONDON

EARLY HISTORY

IT is unlike the French to be unmindful of a son of their country who has rendered notable service in so important a matter as food, yet I am not aware that the achievement of Mège-Mouries is commemorated in France by a public monument or inscription or even by a street name Equally surprising is the scanty information supplied by biographical works of reference about that most ingenious inventor Perhaps we can attribute this to the lack of sympathy one would expect from a nation which appreciates above all other things good food and good cooks, towards one who hoped to pass off the greasy and rather unpalatable products of his laboratory as butter Whatever the reason for such neglect, the fact remains that the French might well be proud to claim the inventor who made possible one of the greatest food industries of our time

It is often erroneously believed that Mège-Mouries set out to concoct a substitute for butter It is true that he was stimulated by the desire of the Victualling Department of the French Navy to find such a substitute ; but he himself was more ambitious He attempted to produce butter itself, and that by a series of laboratory treatments that he thought would reproduce exactly the changes by which he believed body fat to be converted into milk fat in the animal body His laborious process, in which beef fat was digested at blood heat, first with macerated sheep's stomach and then with chopped cow's udder and milk, actually gave him nothing more unusual than the softer portion of the original fat, carrying, presumably, some traces of a milky flavour. Nevertheless, in the early days he was quite satisfied that he had made butter. Others, less optimistic, were content to believe that he had solved the problem of preparing an edible substitute for butter, and for this achievement he was honoured in 1870 by Napoleon III.

Had it not been for the Franco-Prussian War, it is probable that France would have led the world in the technical development of the new process As it happened, the opportunity was seized in the United States and in Holland. In a remarkably short time factories were springing up in these countries for the manufacture of what was then called 'butterine'. It was soon found that Mège-Mouries's complicated digestion was quite unnecessary, and that all it was necessary to do was to mix as thoroughly as possible with skimmed milk, preferably slightly sour, a fat of the appropriate melting point. On separating the fat again it was found to have acquired a buttery taste It could then be 'worked', salted and coloured to taste

Manufacture in Great Britain lagged far behind in the seventies. So far as can be judged from the contemporary press, the home-produced material was, moreover, of very inferior quality Most of it was made in small, dirty, 'back-street' premises under highly insanitary conditions. To a large extent it was knowledge of these facts that gave 'butterine' so bad a reputation at that time The English public was ready to believe any fantastic yarn about the doubtful nature of the fats used by the manufacturers, and they also suspected, often with more reason, that a good deal of the despised stuff was employed as an adulterant for butter. The passing of the Margarine Act in 1887 did something to allay uneasiness, nevertheless, the reputation of the new food remained an unsavoury one for a good many years.

IMPROVEMENTS IN MANUFACTURE

Then in 1889, Otto Monsted opened the first up-to-date factory in Great Britain. The pioneers were faced with a truly formidable task. Prejudice against margarine was at that time shared by rich and poor alike, and opposition from certain other trades, particularly the dairy industry, was vigorous and none too scrupulous The product Monsted turned out was made from that fraction of beef fat which is known as 'oleo' or 'premier jus' It was, in fact, a highly digestible fat possessing a calorific value equivalent to that of ordinary butter and, what was of great importance although unknown at the time, its vitamin A, and probably also its vitamin D, content was by no means negligible. It is probable that its nutritive value was not far below that of ordinary 'average' butter ; but it is difficult to make a proper estimate because it is a curious fact that an extensive modern literature on the vitamin contents of foods does not give us any information as to the A and D value of the common edible body fats such as those of beef or mutton.

By comparison with our modern margarines these primitive materials were undoubtedly very crude. They were inclined to be unpleasantly

greasy, to stick to the knife, and to spread in a manner unattractive to those used to butter. Moreover, they often had a 'fatty' taste and smell which many people disliked

No problem has given the margarine manufacturers more trouble than that of producing a texture resembling that of dairy butter. The introduction about 1890 into margarine manufacture of vegetable oils suitable for blending with 'oleo' helped them to some extent, but it was not until some years of the new century had passed that their fortunes turned By this time the small producer was dropping out of the picture and with him many brands of dubious quality which had served to keep alive an unenviable reputation. To an ever-increasing extent manufacture was passing into the hands of large commercial organizations guided by directorates not only anxious to provide the consumer with an article of high quality, but also prepared to spend very large sums of money on scientific and technical research to that end One by one the problems were attacked and solved. Care in the selection of oils for blending; improved methods of emulsifying the mixture with pretreated separated milk, controlled crystallization of the final product to get the right 'grain'; special precautions to be taken in 'working' a mixture differing in many subtle characteristics from butter; such knowledge, gained by patient and costly research, brought about remarkable improvements in respect of that almost indefinable but all-important character of texture. Chemists, biochemists and bacteriologists collaborated to select the appropriate bacterial flora which would produce in the separated milk just the right blend of substances necessary to impart to the margarine that elusive 'butter flavour' Others ingeniously prepared chemical flavouring substances to serve the same end.

Another important milestone was the introduction of 'hardened' vegetable and animal fats.

Such have been the labours that have gone to produce the high quality of the popular butter substitute we know to-day

VITAMIN REINFORCEMENTS

The period of the War of 1914–18 is very important in the history of margarine. At that time most authorities on dietetics regarded margarine as a reasonably good substitute for butter, because it was well digested and for all practical purposes provided the same heat-producing power. It was one of the cheaper forms of energy.

During the latter part of the War, however, the importance of the fat-soluble vitamins, discovered a few years before, gradually came to be recognized. The nutritive worth of edible fats could no longer be assessed solely in terms of digestibility and energy equivalents. It was necessary to ascertain whether they would also provide the newly discovered constituents. Butter was found to contain them. On the other hand, most of the vegetable oils and fats then being used more and more extensively in margarine manufacture, as well as the hardened fats which had come into use soon after 1910, were found to be defective in this respect Following up the obvious line these observations indicated, the late Prof. W. D Halliburton and I examined a number of typical margarines and found that their nutritive value for the growing animal was determined by the vitamin contents of the constituent oils and fats. Margarines prepared almost solely from beef 'oleo' appeared to be as nutritive as butter, whereas the vegetable oil margarines, in spite of being excellently assimilated, did not supply the fat-soluble 'growth-promoting' factors needed by the young animal.

These observations made little impression on the margarine industry at the time Such reaction as there was consisted of frank scepticism. Some people challenged the conclusion that vegetable oil margarines were devoid of vitamins by directing attention to the fact that milk, which in a vague sort of way was thought to be one of the richest sources of the accessory factors, was employed in the manufacture of the products. Others refused to acknowledge that experiments on rats could have any bearing on human nutrition Others, again, argued that such small differences in composition of a single article of diet could scarcely be of any practical significance Nearly ten years passed before serious attention was given to the matter Then, at last, the margarine manufacturers moved. Many of the earlier attempts to raise the nutritive value of their products by the addition of vitamin preparations were failures For the most part they were attempting to employ materials and concentrates prepared from cod liver oil. It was not a difficult matter to add sufficient of such supplements to bring the vitamin value of margarine up to that of an 'average' butter; but it was found that such additions almost invariably ruined the flavour and palatability besides materially increasing the cost.

The first real progress was made after the discovery of the method for preparing pure crystalline vitamin D_2 from ergosterol. It then became possible to raise the antirachitic value of a margarine at a very slight cost without affecting edibility in the slightest. To confer on margarine a vitamin D activity of 30 units per ounce, it was necessary to add only one ounce of vitamin D_2 (calciferol) to 120 tons of margarine. What was next required was a cheap and effective source of

vitamin A It was found in one of the by-products of the whaling industry operating in Antarctic waters Like other mammals, the whale stores considerable amounts of vitamin A group in its liver, though on the other hand it has curiously small reserves of D. The development of the factory-ship organization in the far southern waters made available large quantities of whale liver fat. It had the advantage not only of being valuable as a source of A but also of yielding material which could be employed without impairing the flavour of the finished margarine By employing this supplement and at the same time adding artificially prepared vitamin D, the production of a satisfactory 'vitaminized' margarine for the ordinary market was achieved Brands prepared with such additions first came on the market about six years ago Not unexpectedly, they aroused a good deal of hostility from the butter industry, and there have been sharp controversies between the rival interests With the many and widely differing aspects of these controversies we cannot be concerned here Suffice it to say that in one country at least a rather bitter trade war has been terminated by a government-inspired 'gentleman's agreement' to 'live and let live'.

More recently, success has rewarded efforts to prepare from fish liver oils concentrates of A and D suitable for adding to margarine They are prepared from liver oils of very high initial potency. So small an addition is required that the palatability of the final product is unaffected, and, what is so important, the cost is almost negligible.

MARGARINE IN THE NATION'S DIET

It is very important, particularly at a time like the present, to try to get such a valuable foodstuff as margarine into proper perspective with the diet of the nation. In 1938, a year in which butter was, generally speaking, cheap, the weighted average consumption per head of the population of Great Britain was 7·6 oz. a week, while the corresponding figure for margarine was 2·3 oz. Even the people classified in the poorest category of the population purchased, on an average, 4·5 oz. of butter per head per week.

If we take, as a peace-time basis for our argument, 10 oz. per week as a rough and ready estimate of the consumption of butter and margarine by the people of Great Britain in 1938, and if we also assume that the whole supply had the same vitamin content as an 'average' butter, we find a weekly intake of, approximately, 5,500 units of A and 150 units of D. Had the whole ten ounces been an 'average' vitamin-reinforced margarine, the intake of A would have been somewhat less, whereas the D supply might have been nearly twice as large In either event, these quantities approximate more closely to the requirements of the individual for one day than to those for a whole week.

In other words, the 'average' individual is more dependent on milk, eggs, green vegetables, etc., than on butter and 'vitaminized' margarine for vitamins A and D

It is very important to remember, therefore, that the consumption of these alternative sources of fat-soluble vitamins is pitifully small among the poorer sections of the community. Under such conditions the question of the vitamin content of margarine assumes greater importance

A consumption of 4 5 oz of butter weekly—which is slightly more than the official ration—together with the balance of 5 5 oz —assuming once again a total intake of 10 oz.—in the form of a 'non-vitaminized' margarine, would provide a mere 2,500 units of A and 70 of D That is scarcely a conspicuous contribution to what the body requires Such figures signify that a good proportion of the poorer people were receiving insufficient of these two vitamins under the relatively good conditions prevailing in 1938 There is evidence from other sources that this was so

The deficiency was, of course, very much more serious at the end of the War of 1914–18, when rationing restricted weekly supplies to 1 oz. of butter and 4 oz. of margarine, none of the latter being 'vitaminized' From these foods the individual could count on little more than 550 units of A and 15 units of D in a week—about one tenth of an adult's daily needs!

With rationing of butter in force, and having in mind the limited purchasing power of the poorer sections of the community, the desirability of enriching all margarines with vitamins A and D supplements must appear obvious

At the present time a large proportion of the margarine sold over retail counters is so enriched. Unfortunately, there does not appear to be uniformity between the various brands, although for the purpose of general estimates such as have been made in this article, the content of an 'average' vitaminized product can be taken as 450 units of A and 30 units of D per ounce A weekly supplement to the butter ration of 6 oz. of reinforced margarine could be regarded, therefore, as adding some 2,700 units of A and 180 units of D to the diet. It is certainly nothing to boast about; but one must remember how valuable is every unit where poverty diets well below the marginal nutritional level are concerned.

It will not be possible to plead ignorance this time if vitamin deficiency is allowed to be responsible for a decline in general health such as occurred during the years of 1914–18.

TOWN'S REFUSE AS A SOURCE OF SOIL ORGANIC MATTER

By Dr. E. H. Tripp

ALTHOUGH animal and vegetable wastes have been used as manure for untold ages, and their good effect on soil fertility has never been in doubt, chemists and microbiologists would be the first to confess that there are many gaps in our knowledge of their modes of action To take farmyard manure—still without a rival—we know the value of the plant foods it contains, and its remarkable power, after decomposition, of promoting and conserving the granular structure of the top soil, thereby making it porous to air, absorptive and retentive of moisture. How this physical effect is brought about is still largely a matter of hypothesis; and generally speaking, we know nothing of the sequence of changes that follow the incorporation of farmyard manure with the top soil

The solution of such questions would help in determining beforehand the possibly beneficial action of many other organic substances that are or might be available to eke out our diminishing supplies of farmyard and stable manures At the present time, when it is planned to convert millions of acres of inferior grassland into arable, the provision of additional supplies of humus-forming material becomes exceptionally important

A potential source of supply of organic manure is the refuse of cities and large towns that is now carted away and dumped on to waste land or into the sea. The composition and production of such refuse have, *inter alia*, been investigated by a sub-committee of the Institute of Public Cleansing, and reported upon by H. Edridge (1937). Samples of the refuse collected from 485,894 houses, with 2 082 million people, contained an average of 13 23 per cent of vegetable and putrescible matter, corresponding to more than one million tons of such matter contained in the estimated total of 8·3 million tons for the entire annual output of the United Kingdom. The percentage of organic matter in the refuse varied considerably with the class of dwelling; that from artisans was 9 96, from the middle class 15 33, and from the 'better' class 16·62 Paper averaged 14 29 per cent, and rags 1·89 per cent

The question arises, therefore, whether such refuse can be used as an organic manure, either directly or after processing. As criteria of suitability the main considerations are contents of nitrogen, cellulose and lignin, and rate of decomposition in the soil. Although little work has been done in these directions, a few practical men have been forestalling scientific inquiry. The Corporation of St Albans, Herts, is producing material that is reported to have given good results on neighbouring farm land, and the Royal Borough of Kensington is disposing of all its refuse to a private company that is converting it into an organic manure in a plant designed to treat 250 tons a day, situated at Wood Lane, London, W. A similar plant is to be in operation at Harrow early in 1940 The process is simple · grosser solids like metal containers, glass, and paper are picked out by hand on moving belts; the material is crushed, sprayed with a culture of nitrogen-fixing bacteria, and then allowed to ferment, aerobically and anaerobically, for sixteen days in large chambers The product has little odour, and is a coarse brown powder containing about 30 per cent of organic matter (with about 1 per cent of nitrogen), 40 per cent of inorganic solids, and 30 per cent of moisture

Large-scale replicated experiments to determine its manurial value were undertaken by the Rothamsted Experimental Station on a wide variety of soils at Rothamsted on kale, Woburn on sugar-beet, Tunstall (Suffolk) and Siddlesham (Sussex) on potatoes, and at High Halstow (Kent) on mangolds. The treated town's refuse (termed 'Hyganic') was compared with farmyard manure, rape-dust, and sulphate of ammonia in single and double doses The chief interest lies in the comparison with farmyard manure at Rothamsted where, on an equal nitrogen basis, 'Hyganic' proved superior three times out of four; and at Woburn where, although the differences in terms of sugar per acre were not statistically significant, there was an advantage of 3 cwt. per acre of sugar in favour of 'Hyganic' when double dressings (1 6 cwt nitrogen per acre) were applied. The value of the nitrogen in the manure was found to be nearly equal to one half that in sulphate of ammonia.

The results apply to the year of application only (residual effects were not examined), but they show that the organic matter in the town's refuse decomposes quickly, rendering the contained nitrogen readily available. The relatively rapid decomposition in the soil may well be associated with the beneficial effect on soil texture, which has been observed by market-gardeners and others, thus supporting Geltzer's generalization that the rate of decomposition of organic matter in a soil is directly related to the stability of the larger soil-aggregates that determine a good tilth.

MAGNETISM AND THE STRUCTURE OF MATTER*

By DR. KATHLEEN LONSDALE
ROYAL INSTITUTION, LONDON

THE first attempts at an explanation of magnetic phenomena were mainly concerned with the problem of action at a distance, but later the centre of interest shifted to the mechanism within the magnetized body which came into action under the influence of the external field After the discovery by Oersted of the magnetic effect of an electric current, Ampère suggested in 1825 that a hypothesis of molecular currents might explain induced and permanent magnetization At the time, only ferromagnetic phenomena were known, but the design of powerful electromagnets enabled Faraday to make the fundamental discovery that all matter is affected to a greater or less degree in a magnetic field There are two broad types of behaviour · diamagnetic substances tend to move from the stronger to the weaker part of a non-uniform field and to set their longest dimension at right angles to the lines of force , paramagnetic substances move from the weaker to the stronger part of a field and set their length along the lines of force Faraday showed that the resultant flux (lines of force per square centimetre) within a diamagnetic body must be less, while the flux within a paramagnetic body must be greater, than that in the external field. That means that the induced magnetization within a diamagnetic body opposes the inducing field, while that within a paramagnetic body reinforces the field

Weber suggested in 1854 that if electric currents could exist within molecules, then substances might be divided into two classes according as to whether their molecules had a resultant magnetic moment due to circulating currents or not Only the former could show paramagnetism This is the basis of the Langevin theory. The atom is now known to be built up of particles of a certain mass and charge, the velocity and distribution of which can be varied under certain conditions. Magnetism is a property of these ultimate particles, because a moving charged particle is equivalent to a current in a circuit and therefore possesses a magnetic moment

DIAMAGNETISM

Diamagnetism is due to induced currents within the atom, these induced currents taking the form of a modification of the existing motion of the electrons. The orbits precess about the field direction, and this extra electronic motion gives rise to a magnetic moment the value of which depends on the field strength, the electronic mass and charge, and the projected areas of the electronic orbits The gram atomic susceptibility (ratio of the intensity of magnetization per gram atom to the inducing field) is entirely governed therefore by the distribution of electron density in the atom All atoms show diamagnetism, but unless the resultant angular momentum of the atom is zero in the absence of a field, paramagnetism or ferromagnetism will also be present and the diamagnetism is relatively unimportant.

The susceptibilities of the inert gases have been measured and compared with those calculated from spectroscopic knowledge of the electron density distribution Other atoms or groups of atoms may attain zero resultant angular momentum in three principal ways. In *ionic compounds* the component atoms may give or accept electrons, so that the external shells of each are completed This occurs, for example, in the alkali halides The susceptibilities of such polar compounds are additive, but when the compounds are dissolved in water, only dilute solutions show additivity. In concentrated solutions the ions not only depolymerize the water, but also form hydrates and other complexes The electronic structure both of the ions and of the water molecules is deformed, with a consequent change of susceptibility. The structures of light and heavy water and of water of crystallization are also being studied by measurements of susceptibility

In *homopolar compounds* the atoms share electrons, thus completing their electron shells or pairing off their odd electron spins The diatomic molecules H_2, Cl_2, Br_2, etc., are diamagnetic because the electron spin of one atom is antiparallel to that of the other In O_2, however, the electron spins are parallel, giving rise to a strong paramagnetism Nearly all organic compounds are diamagnetic, and Pascal has shown that their molecular susceptibilities obey an additive rule $\chi_M = \Sigma\chi_A + \lambda$, where λ is a factor which makes allowance for the different kinds of valency bonds This rule can be used for the determination of chemical constitution in doubtful cases, and for the study of polymerization. Complex compounds are frequently diamagnetic because the effective atomic number of the complex group is equal to that of an inert gas, but this alone is not a sufficient criterion. The state of the electrons taking part in the formation of chemical bonds

* Substance of a special course of lectures for students, given at the Royal Institution on November 29, December 6 and 13, 1939.

is important Measurements of susceptibility are now being used to investigate the constituents of natural products, including blood.

In *metallic compounds* the valency electrons become free electrons having a small resultant paramagnetism, while the positive metallic ions will be diamagnetic if their outer shell is closed Thus many metals are weakly paramagnetic or diamagnetic In some semi-metals such as bismuth, antimony and graphitic carbon, the binding electrons are not really free ; their energy states bear a definite relation to the crystal structure and this results in high diamagnetism and large anisotropy, both of which disappear on melting or can be radically changed by the solution in the solid of small quantities of other elements

Normally, diamagnetism is independent of temperature and of change of state, but a metal which becomes superconducting at very low temperatures always becomes also strongly diamagnetic Except for a very small surface region, no flux can penetrate an ideal superconductor, the permeability being zero throughout the interior of the metal and changing from zero to unity in a region of about 1000 A width below the surface. The supercurrent, which exists only in this surface region, is according to the theory of London a stationary current dependent upon the presence of a magnetic field, similar to that in a large diamagnetic atom In wires, films or particles of dimensions comparable with 1000 A, the susceptibility is only a fraction of that of the bulk superconductor Slater has suggested a molecular model for the theory of London on the basis of semi-bound electrons with very large wave-functions, and explains the 'threshold field' as that value at which the Larmor precession energy becomes comparable with the 'atomic' energy.

In aromatic organic compounds there are electrons which occupy large plane orbits, and this results in a large molecular anisotropy. From the principal susceptibilities of single crystals of such substances, it is sometimes possible to determine the orientations of the molecules, or if the crystal structure is known to deduce the electron distribution in the molecule.

PARAMAGNETISM AND FERROMAGNETISM

Any atom or ion will be paramagnetic that does not succeed in completing its outer shell or in pairing off its electrons The inner closed shells contribute only to a correcting diamagnetism. The resultant magnetic moment of the atom is measured in Bohr magnetons (μ_B) and is dependent upon the motion and distribution of the odd electrons, that is, upon their momenta. Electrons can have orbital (L) and spin (S) momenta, which combine to give a resultant angular momentum (J). All of these are quantized, that is, they can only have certain values. The angle between the resultant angular momentum and the magnetic field direction can also only have $(2J + 1)$ discrete values. The gyromagnetic ratio, which is the ratio of angular momentum to magnetic moment, is $2m/e$ for orbital motion, m/e for spin motion and $2m/ge$ for the whole atom, where g, the Landé splitting factor, is dependent only on L, S and J.

In the Gerlach-Stern experiment a stream of free atoms from an electric oven passes through an inhomogeneous magnetic field and is received on a cold glass plate, the vapour pressure in the apparatus being low so that no collisions take place. Paramagnetic atoms will be both orientated and deflected, giving $(2J + 1)$ separate traces, the separation of which depends upon g. Hence the one experiment gives both angular momentum and magnetic moment of free atoms. Data so obtained agree well with those determined from spectroscopic measurements A modification of the method can give the spin momentum and magnetic moment of the nucleus Even for large atoms containing many protons and neutrons the largest nuclear spin observed is 9/2, indicating that the nucleus itself may have a shell structure, only uncompensated particles contributing to the resultant momentum The magnetic moment of the proton is 2·85 nuclear magnetons ($\mu_N = \frac{1}{1840}\mu_B$), from which it appears that the proton itself may not be a single particle.

When the effective magnetic moments of bulk substances containing paramagnetic ions are measured, it is found that the rare earth salts give results which agree well with theory, whereas salts of the transition series have susceptibilities considerably lower than theoretical values This is due to quenching of the orbital moments in the latter by electric fields due to neighbouring atoms ; this effect may introduce asymmetry in the case of crystalline fields The incomplete group in rare earth ions is largely shielded from such interaction by an outer completed shell.

Paramagnetic saturation can only be approached at very low temperatures using enormous fields and substances of large magnetic moment. At ordinary temperatures the susceptibility varies inversely with absolute temperature (Curie's law) or with the excess temperature above a critical value θ (Curie-Weiss law). In the latter case it appears as if, within the substance, there were an extra field adding to the effect of the external field. This inner field is much too large to be of purely magnetic origin and is attributed to exchange interaction between electrons of neighbouring atoms.

Below the Curie point, θ, it is possible for a spontaneous magnetization to exist in certain cases

even in the absence of an external field. This magnetization, which varies from complete saturation at 0° A. to zero at the Curie point, is identified with the 'saturation' intensity of ferromagnetic substances appropriate to each temperature. Above their Curie points, all ferromagnetic substances are paramagnetic and obey the Curie-Weiss law The intrinsic magnetization of a ferromagnetic is uniform in direction only throughout small regions or domains the average size of which is about 10^{-9} c.c., containing some 10^{14} atoms. The directions of magnetization of the various domains may be random and their resultant nil, but a small field is usually sufficient to align moments of individual domains Single crystals have certain axes of easy magnetization which would appear to be the natural directions of spontaneous magnetization. Measurements of the gyromagnetic ratio prove that the elementary magnetic carrier is the electron spin. Heisenberg showed that intrinsic fields of the right order of size could arise from exchange interaction between electron spins The condition for a large-scale alignment of spins is that the ratio of the distance between neighbouring atoms to the radius of the energy shell in which uncompensated electron spins exist shall lie within certain limits. The ratio has the right value for iron, cobalt, nickel, and for some of the rare earth metals; chromium and manganese lie just outside the range, but certain compounds and alloys containing these elements (notably the Heusler alloys) are ferromagnetic.

The first few atoms of an impurity do not markedly affect polycrystalline ferromagnetic materials, but if the number of dissolved atoms becomes larger than the number of domains, then even very small percentages of carbon, oxygen or sulphur can greatly lower permeability and increase hysteresis The addition of silicon has the effect of causing these impurities to crystallize out in forms in which they are relatively less harmful. Much work has been done on the technical side in these directions, and in the preparation of 'soft' and 'hard' magnetic materials Recent X-ray work has revealed why it is that alloys prepared under certain conditions of heat treatment make excellent permanent magnet material.

OBITUARY

Mr. Wilfred Trotter, F.R.S.

IN the recent autumn the Royal Society has suffered the loss of both of its fellows whose work lay in surgery, Harvey Cushing of America, who died on October 7, 1939, and Wilfred Trotter of London, who died on November 25 at the age of sixty-seven. Each had done conspicuous work in the surgery of the brain, approaching their problems with physiological thought, and Cushing's name will always be remembered for the studies by himself and his pupils on the pituitary gland and on the microscopic structure of brain tumours in reference to their ways of malignant growth. He was a pioneer in cerebral surgery in America, and his supreme powers both as an operator and as a scientific thinker soon gathered around him at Harvard a school of workers who will assuredly maintain the energetic influence left by Harvey Cushing's mind. The possibility of this broadly based success was a reward of the changes deliberately planned in American universities in order to enable a leader in medicine or surgery to receive all such laboratory and other advantages as a professor of physiology would expect in his department for the progress of scientific work and teaching.

Trotter was too early in England for such an opportunity, and much of his life was perforce spent in individualistic effort as a consulting surgeon. At University College Hospital he inherited the field of Sir Victor Horsley's work and soon proved himself to be a master of the surgery of the brain and of the thyroid gland. He wrote a general analysis of the physiological processes involved in cerebral concussion which influenced surgical thought widely. A new approach to the difficult tumours of the pharynx was devised by him, and in this and equally in all the familiar operations of surgery he worked with such technical perfection and delicate care of every detail for the welfare of both wound and patient that none could surpass his results. Practice as a London consultant grew rapidly, and from 1932 onwards Trotter had the honour of being sergeant surgeon in succession to three kings of England. But at that zenith of individual success he made a choice which to ordinary ambition seemed utterly paradoxical. His health was becoming unequal to the fullest strain of work, and so about 1934 he withdrew, not from unpaid hospital duties at his medical school, but from all private practice. He wished, while he still could, to teach the young men.

Trotter's influence on those around him at University College Hospital had at all times been profound. The fine lines of his face and the quiet perfection of everything said or done by him were united with a keenness of intellect that was stirringly eager to aid the minds of others and never stood aloof. His method was like that ascribed to Socrates, a conversation in which he would relentlessly, yet never with discourtesy or overbearing force, compel those sharing it to think afresh, to see

through time-worn phrases, and to discover the foundations, if any, of their beliefs. Any question would serve him for the method—surgical, medical, ethical, or artistic; and a light irony would always keep the talk at human levels. He seemed to have realized completely the old precept "Know thyself", and through that discipline to have gained the power to influence the minds of all others.

Trotter's intense interest in the human mind inspired the first as well as what chanced to be the last of his publications ("Has the Intellect a Function?", *Lancet*; June 24, 1939). In 1905, when demonstrator of anatomy at his medical school and waiting in the hope of appointment to the surgical staff, he produced none of the conventional apprentice papers in surgery but wrote for the *Sociological Review* an illuminating article on herd instinct. This was enlarged and republished in 1915 as a small book analysing the mentalities of nations then at war. Describing himself in it as a biological psychologist, he sought to compare with objective detachment the workings of the mind and of instinct in man and in animals, and he found associated with the gregariousness of man and of many creatures a powerful herd instinct that could be used to explain much in human behaviour.

But his surgical training and his exact sense of scientific values made Trotter reluctant for speculation that could not be tested by observation, and his later writings on such questions were those of a wise philosopher surveying the world of medicine rather than of a formal psychologist. The question of pain often occupied his thoughts, and during the earlier period when he had some leisure for experimental work he published in the *Journal of Physiology*, 1909, an important series of observations made with Morriston Davies on the nature of the sensations found during restoration of function of various skin nerves that had been deliberately cut in themselves. This work was done to test the generalization as to the existence of separate epicritic and protopathic nerves that Head and Rivers had made upon one experiment. Afterwards Trotter himself suggested a most attractive generalization, that pain arose when body tissues were in contact with naked and uninsulated nerve fibres; but then he had no leisure to test his view experimentally nor pupils to whom he could give the problem.

For a period, 1935–37, that was too brief and too late for work of his own, Trotter accepted the post of director of the Surgical Unit at University College Hospital as a temporary successor on the retirement of Prof. Choyce, because he regarded the welfare of such departments as of the highest value to a medical school. His eminence as a surgeon naturally gave him a seat for many years on the Council of the Royal College of Surgeons. He also served clinical science by his membership of the Medical Research Council during 1929–1933; and he was twice chosen for the Council of the Royal Society, on the second occasion being named as a vice-president. Trotter never avoided committee work, for he was eager to guide practical progress. But he cared little to popularize his name in general surgery, and the writings by which he became more widely known in the medical world were his short papers and addresses on the general theme of medical science. They gave his message of the need for clear thinking. But few men have the power to think as penetratingly as Trotter could always do, or to state their thoughts with such clearness and perfection of language.

T. R. E.

WE regret to announce the following deaths:

Mr. W. A. S. Calder, president of the Institute of Chemistry, on January 6.

Dr. W. B. Worthington, formerly engineer-in-chief of the Midland Railway, president of the Institution of Civil Engineers during 1921–22, on December 29, aged eighty-five years.

NEWS AND VIEWS

Margarine

Now that rationing of certain articles of diet has begun in Great Britain, interest is naturally being concentrated on substitute foodstuffs. In the recent past, margarine has not enjoyed much popularity, even among the poorer people of the country. This has been due partly to a not too savoury history and partly, no doubt, to ignorance of its constitution and dietetic value. Present-day brands of margarine cannot be considered in any way *Ersatz* butter, but will, once prejudice has been eliminated by experience, prove complementary to the adequate amount of butter allowed under the present rationing scheme. At present, margarine is not being rationed; therefore until it becomes necessary to ration cooking fats, its greatest value lies in eking out our butter supplies.

The plain statement of facts about margarine in an article beginning on p. 53 of this issue of NATURE, by Prof. J. C. Drummond, should do much to allay suspicion of, and counteract ill-founded prejudice against, this important commodity. Prof. Drummond has been University professor of biochemistry in University College, London, since 1922, and his deep practical knowledge of biochemical and physiological problems is now being utilized by the Ministry of Food, to which he is attached. His account of the early history and later improvements of manufacture of margarine will be read with interest, while the description of vitamin reinforcements should convince those still sceptical that margarine is a valuable article of food not only from the point of view of nutrition but also from that of health.

Sir John Reith, Minister of Information

SIR JOHN REITH, chairman of Imperial Airways, Ltd., has been appointed Minister of Information in succession to Lord Macmillan; the way is thus open to bring into the House of Commons the minister in charge of a department the working of which has been severely criticized ever since it began to function on the outbreak of war. Sir John is perhaps better known as the director-general during 1927–38 of the British Broadcasting Corporation, having been managing director of the British Broadcasting Company which preceded it. Hence he was largely responsible for the guidance and development of the broadcasting service of Great Britain in its early and critical days, when its functions were ill-defined and its merits as a vehicle of entertainment, of news and of education for the masses were much debated.

Before he became associated with broadcasting, Sir John was for a short period general manager of the well-known engineering firm, Wm Beardmore and Co., Ltd. This followed Government posts in charge of munition contracts after and during the War of 1914–18, in which he served with the Royal Engineers. Sir John is an engineer by profession, having passed through the Royal Technical College, Glasgow, and served a five-years engineering apprenticeship in Glasgow. He is a member of the Institution of Civil Engineers. While his professional knowledge was no doubt of service during his eleven years with the B.B.C., it was his forceful character and administrative ability which were outstanding; these, with his experience of public affairs and the Press, will be invaluable assets in the chief of a young department which is capable of making invaluable contributions to the influence and prestige of Great Britain and to the morale of the people at home

The British Association

THE General Committee and the Council of the British Association held a joint meeting last week, at which Sir Albert Seward, the retiring president, handed over the chair of the Association to his successor, Sir Richard Gregory It was reported that, by agreement between the authorities at Newcastle and the general officers of the Association, arrangements for the meeting of the Association which had been appointed to take place in that city next September were in abeyance, and that a meeting there was not contemplated, save in the event of an early peace.

The Committee of the Association therefore proceeded to a discussion of the desirability and possibilities of a meeting being held, in some modified form, and in some other place. As to desirability, there was general agreement; as to possibilities and places, various suggestions were put forward, and in the upshot the general officers were instructed to make the best arrangements they can for some sort of an abbreviated meeting. Whether as part of such a meeting, or independently, the potential activities of the Division for the Social and International Relations of Science will be taken into consideration. No action has been taken to appoint new sectional officers for the year; but the general officers were instructed to consult those who held such offices last year, and any others whose advice and help would be appropriate.

Scientific Workers and the Armed Forces

THE Ministry of Labour and National Service announces that the operation of the Schedule of Reserved Occupations is being relaxed to enable men at or above the age of reservation in scientific occupations to volunteer in approved cases for service in the Forces. Such men have previously been able to join the Forces in their professional capacity, and the present relaxation of the schedule is designed to enable those whose services are not required in a professional capacity in the Forces or as civilians to volunteer for other forms of service To secure that scientific workers shall not be withdrawn from civil work to the detriment of the national interest, and that an adequate reserve of scientific workers is maintained for essential services, the Scientific Research Committee of the Central Register Advisory Council will consider applications from volunteers with the view of ensuring that relaxation is granted only in suitable cases Any reserved scientific worker who wishes to volunteer should apply to the Ministry of Labour and National Service (National Service Department), Montagu House, Whitehall, S.W 1

Scientific Workers and the War

A SYMPOSIUM, organized by the Faculty of Science of Marx House, Clerkenwell Green, London, E C.1, was held during the week-end of December 30–31, the title of the meeting being "The Position of Science and Scientists in the War Situation". No adequate assessment of the effect of the war is possible without some knowledge of the economic background, and this was afforded by Maurice Dobb in a paper entitled "The Economics of War Capitalism". It was with this background that the meeting held a discussion on the effects of the war on university research and education, opened by Prof. H. Levy. It was argued that the cost of the social services would be cut, and in this respect, the maintenance of the universities on the present scale would be regarded as an unnecessary luxury, with adverse effects on staff, students, and standards of education Mr. Roscoe Clarke, in discussing the scientific social services, showed that the incidence of the same problems has been felt in the medical services. The emergency medical schemes have cut right across the normal medical services, already dislocated by the evacuation of schoolchildren. Prof. J. D Bernal, in the concluding paper, dealt with the status of the man of science. The historical role of science in the development of capitalism was analysed, and the effect of the functions of the scientific worker on his status discussed; at the present time, the existing system cannot use to the full the science it has itself brought into being.

The general tone of the discussion as a whole was that scientific workers are more and more

beginning to feel dissatisfied with the role of science and its present applications to human welfare, and that a material change, if not a complete break, will have to be made with the present economic system before science can be fully utilized. Concern at the insecurity of their own position in the immediate future is leading scientific workers to the view that a new type of scientific organization, based on the experience of the trade unions in the defence of the economic and cultural interests of large masses of the population, is becoming necessary.

The Earthquake in Turkey

As the railway between Sivas and the ruins of Erzinjan has now been repaired, it is possible to add a few more details concerning the Erzinjan earthquake of December 27, 1939 (see NATURE of Jan. 6, p. 13). From Ankara to Sivas and Tokat the damage has been done chiefly to the old and badly constructed buildings made from inferior material, whilst the better ferro-concrete public buildings of recent construction have escaped with cracks and minor damage; but from Tokat and Sivas to Erzinjan there has been practically complete destruction of old and new. The only 'oasis' of lesser damage thus far recorded has been at Kemah near Erzinjan, where some buildings still stand, though 548 buildings were wrecked and nearly 150 casualties caused. It appears probable that Kemah was built on more solid rock than the other towns in the area of approximately 15,000 square miles affected

In the mountainous district between Amasya and Tokat there are ground fissures 12 yards wide, out of which are said to issue smoke and sulphur fumes and also jets of boiling water. There is as yet no direct news of some five hundred villages to the east of Erzinjan, although efforts are being made to reach them through a countryside covered to a depth of 12 ft in snow. At Niksar, a rock pinnacle fell on the town, doing much damage, and there were few survivors in this place or in fourteen of the neighbouring villages, whilst on the Black Sea coast the towns of Kerasun and Ordu are reported to have suffered the greatest damage.

At Kew Observatory the first waves to arrive did so at 0h 3m. 26s G.M.T. and the maxima exceeded the limits of registration, the ground movement being greater than one millimeter in amplitude. Several severe after-shocks have occurred as well as hundreds of smaller ones. On January 1 there were seven severe after-shocks at Erzinjan, and a violent shock at 7 a.m. local time at Bergama in the west of Turkey. On January 2 at Yozgad there was a strong shock and 190 houses collapsed, though no casualties are reported. The after-shocks appear now to be decreasing in strength and number. Although the after-shock of January 1 was at Bergama, it is yet uncertain whether the floods in the Brusa and Smyrna districts of Turkey and in the Bilecik Valley (River Sakaria) had anything to do with changes in topography attendant on the earthquakes, nor whether the Kemal Pasha Dams and numerous river bridges were destroyed by the shocks or by the floodwaters, but if the meteorological conditions in the area did not cause the floods, they certainly enhanced them considerably.

Other Recent Earthquakes

ON December 21, San José (Costa Rica) suffered the most severe earthquake it has known since 1923. Buildings were cracked, including the cathedral. though no casualties are reported. The shock was recorded at Manila, at De Bilt (Holland), where the *P* wave arrived at 21h. 7m. 10s. G.M.T., and at Kew. where the first of three shocks in rapid succession arrived at 21h. 6m. 51s. G.M.T, the maximum ground amplitude at Kew being 0·42 mm. On December 22, considerable damage is reported to have been caused by earthquake shocks in Costa Rica, though no loss of life or other casualties are reported. These shocks were possibly after-shocks of the earthquake which rocked San José on December 21.

On December 22 also severe earthquake shocks were experienced in the South Sea islands of Molucca. On December 23 and 24 earthquakes and landslides, which were probably caused by the earthquakes, occurred in Java in the East Indies In addition to the Anatolian earthquake of December 27, further shocks were registered at Kew Observatory on December 25 (2), December 28 and December 29. Further news concerning all these shocks is awaited from the areas concerned and from other seismological observatories. On January 2, early in the day, an earthquake shock was perceptible on the Ionian Island of Zante (Greece), though no damage or loss of life has been reported.

Potatoes in War-time

POTATOES are one of the most valuable sources of human and animal food in war-time, and it is of the greatest national importance that both the acreage devoted to this crop shall be increased and that the maximum yields shall be obtained. Questions of quality, colour and shape must now take second place and yield be the all-important aim of the grower. The National Institute of Agricultural Botany, Cambridge, has just issued a war-time edition of its Farmer's Leaflet No. 3, in which useful information to this end is supplied. Emphasis is laid on the necessity for using healthy seed, as otherwise attention to cultivation, manuring, etc., is of little value. A number of varieties are recommended for both early and main crops; but it is pointed out that to lift potatoes in an unripe condition is an unwarranted waste of tonnage in a time of emergency. As regards choice of varieties, most of those commonly grown are still recommended, but King Edward should be replaced by a heavier cropping kind such as Arran Banner, Arran Consul, Kerr's Pink, Majestic or Redskin.

The use of unsaleable potatoes for animal feeding is the subject of "Growmore" Leaflet No. 10, issued by the Ministry of Agriculture. All potatoes, whether to be used raw or cooked, should be washed before feeding, or digestive trouble may result. Raw potatoes

can be used safely in moderation for cattle, dairy cows and sheep; but they are not suitable for young stock, horses or pigs Cooked potatoes, however, can be successfully fed to pigs of all ages, and a table of suitable quantities is provided. Potato and potato and green fodder silage are other useful ways of utilizing waste tubers, particularly if some of them are slightly diseased, and simple methods for preserving them in this way are described Nutritious food of a feeding value equivalent to about a quarter of its weight of barley meal, and suitable for sheep, cattle and pigs, can thus be produced.

Johann Friedrich Blumenbach (1752-1840)

JOHANN FRIEDRICH BLUMENBACH, a pioneer in anthropology and craniology, was born on May 11, 1752, at Gotha He studied medicine at Jena under Soemmering and qualified in 1776 at Göttingen, where he was appointed extraordinary professor of the practice of medicine in the following year and full professor in 1778. In his thesis entitled "De generis humani varietate nativa" (1776), which according to Garrison is the starting point of modern ethnology, he based his classification of mankind upon the shape of the skull and the facial configuration as well as on the colour of the skin. As the result of his craniological investigations, he divided the human race into five great families: the Caucasian or white race, the Mongolian or yellow, the Malayan or brown, the Negro or black, and the American or red

Blumenbach was a voluminous writer. His principal work, which was published in 1790-1820, was entitled "Decades 1-6 collectiones suae craniorum diversarum gentium illustratæ". He was also the author of "Handbuch der Naturgeschichte" (1779-80), "Ueber der Bildungstrieb und das Zeugungsgeschäft" (1781), "Institutiones physiologicæ" (1787), "Beiträge zur Naturgeschichte" (1790-1811), and "Handbuch der vergleichenden Anatomie" (1805) He was also the editor of "Medicinische Bibliothek" from 1785 until 1795, and contributed many articles to periodical literature. He was a fellow of the Royal Society, member of the Royal Academy of Sciences of Paris, and the recipient of many other honours at home and abroad. He died on January 18, 1840.

Neanderthal Man in Central Asia

A PRELIMINARY account of the discovery of skeletal remains of Neanderthal man in Central Asia is given by Dr. Aleš Hrdlička through the Smithsonian Institution of Washington. The remains—the skull of a child, with the lower jaw and all the teeth, and some of the bones of the skeleton in a fragmentary state—were found by Dr. A. Nokladnikov in a cave of the Gissar Mountains of Siberia. The discovery is of special importance, as not only is this the first example of Neanderthal man to be recorded from Central Asia, but it is also the farthest extension of the type eastward hitherto known. With the exception of the finds in Palestine, all previous specimens have been found in Europe. Dr. Hrdlička, who has had an opportunity of examining the material while on a visit to Siberia recently, regards it as one of the most important discoveries in anthropology of the last two decades, and further as lending support to his view that there is an overlap in skull pattern between Sinanthropus and Neanderthal man.

In an account of the find which Dr. Hrdlička received at first hand from those who were responsible for the discovery, it was stated that the cave deposits contained many splintered bones of deer, leopards, wild horses, goats, boars, marmots and birds. Many of these showed evidence of having been used in the manufacture of stone implements. Most of these implements were made of local limestone, but the finest were of jasper. Good material for implement-making, however, was scarce. Typical Mousterian scrapers and small pointed implements, chipped on one side, were associated with the animal bones, and both were in relation to fire-places. The human skeletal remains were imbedded in a sterile underlying stratum. An interesting feature of their disposal was that they were encircled by five pairs of goat horns, of which three were still united.

Psychology of the Initiate

An interesting sidelight is thrown on certain changes in mentality taking place after initiation by an examination of two series of drawings made by an Australian aboriginal boy, which have been recorded and reproduced by C. P. Mountford, acting ethnologist of the South Australian Museum (*Records S. Austral Mus*, 6, 2, 1939). The subject was one of two interpreters accompanying an anthropological expedition of the University of Adelaide to the Warburton Ranges of Western Australia in 1935 At the time of his engagement it was understood that he was a full initiate, but when an investigation of aboriginal art was being made, it was noted that when drawings of a secret character were being made by tribesmen, they were carefully concealed on his approach. His own drawings in the first series invariably represented objects of, or known to, European civilization.

This fact, coupled with his failure as an interpreter, led to inquiry, when it was found that initiation of the man had not been completed. Though circumcized, he had not been subincized, and consequently in all matters affecting tribal ritual he was virtually ostracized, while his behaviour consorted with that of younger members of the tribe. Full initiation, which was then carried out, induced a remarkable change in his outlook, behaviour, and what from one point of view was of greater moment, in the attitude of other members of the group. The youth assumed the attitude and behaviour of a senior of the tribe; he was no longer prevented from seeing ceremonial drawings and taking part in ritualistic discussions, while, it is interesting to note, his own drawings now depicted the ceremonial designs associated with, or recording tribal traditions. The author's comment is significant. He points out how any interference with tribal ritual by outside influence may prove an effectual bar to association with tribal society, while still not securing an admission to any real participation in white civilization The lesson is instructive.

Supposed Risso's Grampus in the Mersey

THE importance that authorities in tidal districts be acquainted with the fact that, under an arrangement made some few years ago, all large cetaceans stranded on the shores of Great Britain should be offered to the British Museum before any decision is made to dispose of them, is well borne out by the unfortunate destruction of a rare cetacean recently stranded in the Mersey. The flood tide of December 10, stranded a large cetacean in the Mersey at Widnes, and various unofficial reports circulated suggested it to be a porpoise, dolphin, or killer whale. Immediately upon discovering that no local museum or university had been informed of the rarity, the Merseyside Naturalists' Association went to considerable trouble to collect all available evidence and photographs and to interview all people who had handled the specimen. Through some misunderstanding, it appears that although the customs authorities had told the transporter company who recovered the whale that any scientifically interested body could have it, the Upper Mersey Conservators took possession of the carcass the day following its stranding, cut it up into pieces and returned it to the river from one of their vessels.

Evidence which was gathered by the Merseyside Naturalists' Association strongly suggests that the animal was a Risso's grampus (*Grampus griseus*), of which there is no previous Lancashire or Cheshire record. The report of evidence it collected gives: Length, 11 ft. 2 in., upper parts: dark grey, almost black, blotched and streaked plainly with greyish-white, dorsal fin broad and high; head: no teeth in upper jaw, lower jaw with a few rather blunt teeth spaced about 0·75 in. apart; lower jaw a shade shorter than upper jaw; whitish tinge to muzzle and greyish tinge to head; head large and swollen like that of pilot whale; underparts white, smooth; flippers long, narrow and pointed; tail flukes narrow. No scientific measurements had been taken owing to the surprising and unannounced destruction of the carcass, but a photograph taken by a local man had been secured. The specimen was still alive and blowing when stranded and roped.

The Meteorological Office

THE recently issued report of the Director of the Meteorological Office for the year ending March 31, 1939 (H.M. Stationery Office. 9*d*. net), is largely occupied with a description of changes of organization arising from the rapid expansion of the Office, due mainly to the expansion of the Royal Air Force; it contains also an account of the methods adopted for dealing with routine requirements of the different services and of civil aviation. For these reasons a more careful perusal of the report is necessary than has generally been the case in the past in order to find items of purely scientific interest, although, it is curious to note, the decision was made during the period under review to make organized research a part of the normal work of the Office, instead of leaving research to individual enterprise on the part of the scientific staff.

The most important instrumental problem that has been pursued has been the development of the *radio-sonde* method of measuring the pressure, temperature and humidity of the atmosphere up to heights of 10 miles or more. The apparatus arrived at has been developed in collaboration with the National Physical Laboratory. It is carried by a free balloon, and transmits radio signals which are modulated in a manner dependent on the physical state of the atmosphere with which the balloon is surrounded at the moment. Fifty ascents were made, in most of which a Dines meteorograph was attached so that a check on the indications of the radio transmitter was available eventually on those occasions when the instruments were recovered. Much time was spent in trying to eliminate various sources of error that were encountered. Trials of a radio method of measurement of winds at great heights were continued, the method consisting of observations by two distant radio direction finding stations of the position of a small radio transmitter carried by a balloon. The main difficulty arose from the deflection of the radio signals by surface objects, which necessitated elaborate calibration. During the year under review the use of the cloud searchlight for rapid determination of cloud height at night was greatly extended. Improved specifications for pilot balloons were considered, with the view of avoiding the rapid deterioration experienced in hot climates, also improved methods of storage.

Terminal Velocities

DR. HERBERT CHATLEY prepared a paper on 'terminal velocities' for delivery to the Junior Institution of Engineers on October 13. It is now published in the December issue of the *Journal* of the Institution. In many engineering and physical problems of the present day, the question often arises as to the maximum velocity developed when a body falls in a fluid medium. To give a rough idea of the terminal velocities, Dr. Chatley compares the impact velocity of a stream-lined aerial bomb and the speed with which the finest clay suspensions settle in water. Between these speeds he considers the landing speed of parachutes, the fall of rain or oil-drops, the vertical current speeds necessary in coal dust or grain elevators, the suspension of sand or silt in rivers, and the settlement of dust particles in a room.

When an elevated body is released, it falls earthwards according to the law of gravitation. As it proceeds, the resistance of the air or water increases up to a definite value, namely, when this resistance equals the weight of the body. When this happens, the velocity remains constant and is called the terminal velocity. A sand particle one micron in diameter has a terminal velocity in water of about 0·001 mm. per second; in air it is about ninety times as great. One of the most useful applications of the terminal velocity is in the computation of the power required to sustain bodies when placed in a current of fluid. For example, in the elevation of grain from a hopper or ship's hold to a level somewhat above the receiver, out of which it flows to a second container (say, 50 feet

lift), modern plants consume about 0·8 h.p hour per ton. This represents a very low efficiency. In a vertical pipe a fluid ascends more quickly than a suspended material, their relative velocity being the 'terminal velocity' in this case.

A Zinc 'Famine'

ACCORDING to the *Electrical Contractor and Retailer* an idea was current a short time ago that a shortage of zinc was responsible for the recent famine in torch-batteries. This is not the case as there was plenty of zinc in Great Britain and the torch-battery famine was due entirely to the overwhelming Government and public demand for these accessories—and quite naturally so. When a large number of people suddenly resolve to carry flash-lamps, something like a temporary famine is unavoidable. During the life of an ordinary dry battery possibly five per cent of the zinc is consumed and so about 95 per cent of the zinc used for this service is thrown away It looks as if we were surrounded by an appalling waste in various directions Notice, for example, the packing of tobacco and cigarettes for domestic use in 'tins' and then visualize the waste of iron and tin thereby involved. Many of these tins are also provided with substantial rubber seals, all of which are used once and then thrown away. It would be of interest if somebody considered whether this waste is serious or not, and if it is, then investigate how the saving could be effected

Training Physicists

DURING the last six years there has been much discussion in the United States as to the most suitable training for physicists who are required in industry, and the conclusions come to have been summarized in these columns. In general, the training then available was considered to provide a superficial acquaintance with the latest developments of quantum theory and of atomic disintegration rather than a fundamental knowledge of the older physics. Criticisms of the same type were made in the May issue of *Metals and Alloys* this year and were quoted in the July issue of the *Journal of Scientific Instruments*.

In the November issue of the *Journal*, two physicists in the research department of a cable works in Great Britain point out that the criticism applies equally well to the training the universities of Great Britain provide, and that in consequence industrialists are reluctant to employ physicists. They think that the position would be improved if the universities provided some training in applied physics and supplemented it by visits to works and by practical experience in works during vacations.

Fused All-Glass Cells

MESSRS. TINTOMETER LTD., of Salisbury, announce the manufacture of a range of fused all-glass cells suitable for holding liquids for colorimetry, photometry, polarimetry and other purposes. The construction of the standard type consists of a body of a single bend of glass with faces of clear glass sintered to it This avoids the use of the usual cements, which often break down under the attack of alkalis and other solvents. It is claimed that the accuracy of the thickness is within $\pm 4 \times 10^{-3}$ in for cells of one inch or less; moreover, examination shows that *distortion of the faces in the sintering process has* been very largely avoided. Beside the standard types, hollow cubes, prisms, rectangular cells, double light-filter cells, and 'blood' cells are also being manufactured. It appears that these products will form a useful addition to the range of such articles manufactured in Great Britain

Rhodes Scholars

THE "Statement of the Rhodes Scholarships" for the academic year 1938–39 shows that 68 scholars began their English experience, while 188 were in residence. Among the subjects covered, natural science and medicine with 45 representatives, and jurisprudence and the Modern Greats school with 38 each are easily the most popular Agriculture, forestry and music have solitary devotees. The record is good on the whole in academic distinctions, and includes several names well known in sport and athletics. The list of books published by men of the foundation is long. The Rhodes scholars include a dean of Christ Church and a regius professor of medicine They come to England with previous academic training and at an age more advanced than that of the average undergraduate. The question whether this discrepancy is advisable has been the subject of considerable comment

Scientific Research in India

THE progress of research in India can be followed by the help of the *Indian Science Abstracts*, which is an annotated bibliography arranged by subjects Some of these bear closely on the economic development of the country, and their principal interest is local rather than general. Part 1 for the year 1937 covers mathematics, physics, geology and botany (National Institute of Sciences of India, September 1939) Mathematics has 86 papers, five of which deal with Indian geodesical problems, physics has 189, only a dozen of which deal with local meteorological or geophysical subjects, geology has 316 and botany 286, dealing almost exclusively with Indian problems.

Alchemical Manuscripts

VOLUME 6 of *Osiris*, dedicated to Prof. Bidez, contains his portrait and a bibliography of his publications. The rest of the volume of 844 pages consists of a "Catalogue of Latin and Vernacular Alchemical Manuscripts in the United States and Canada" by W. J. Wilson, of the Library of Congress, Washington. After a brief but very interesting general introduction, the text consists of detailed and annotated analyses of 79 manuscripts, with 41 facsimile figures. The dates of the manuscripts range from the thirteenth to the nineteenth centuries. Many of them contain collections of recipes. There is a very full index (pages 690–844). The work is thorough and reaches a high standard of scholarship.

it is a notable addition to the literature of a subject which has recently attracted a good deal of attention, namely, the history of alchemy.

Early Works on Medicine and Science

WE have received from Messrs Goldschmidt and Co., Ltd, 45 Old Bond Street, W 1, their Catalogue No. 53 listing rare early works on medicine and science Pride of place is occupied by a good and large copy in vellum of the first edition of William Harvey's "De Motu Cordis" (1628), and also a copy of the rare third edition of the same work. A complete set of Conrad Gesner's "Natural History" (1551), three of Kepler's important works, a work by Joseph Black on alkalis (1770) and William Withering's "An Account of the Foxglove" are also to be noted. A number of less rare though none the less important books and tracts by Erasmus Darwin, Euler, Faraday, Fayrer, Fraunhofer, Stephen Hales, Mendeléeff, Pasteur, Lister, Fox Talbot and many others are also listed

Medical and Scientific Lending Library

PART 2 of the new edition of the "Catalogue of Lewis's Medical and Scientific Lending Library", revised to the end of 1937, has now been issued (London: H. K. Lewis and Co., Ltd, 136 Gower Street, W.C.1. *16s. net; to subscribers, 8s.*). It contains the classified index of the subject-matter of the books, with the names of their authors, upon medical and scientific subjects contained in Lewis's Library. An extensive subject is subdivided to facilitate reference; for example, chemistry has eleven, and agriculture thirteen, sub-headings The date of publication is given, and a note is frequently added to indicate the scope of the work It will be appreciated what a large number of works is listed when it is mentioned that the text occupies 156 pages, each with three columns and each column containing authors' names of some 30–45 works. The catalogue should therefore prove a very useful general guide to medical and scientific books.

Big Sunspots

A BIG group of sunspots, originating about January 1 and growing rapidly, crossed the sun's central meridian on January 5 and reached the west limb on January 12. Between January 2 and 4, the area increased tenfold and measured 1,300 millionths of the sun's hemisphere on the latter date. Still expanding on January 5, the spots were clearly seen with the naked eye through the morning mist. In structure, the group was a typical stream with leader and follower spots and subsidiary spots in between. This group is the largest since last September, and indicates that, although the maximum of the 11-year cycle is past, the sun is still generally active.

Royal Institution Discourses

THE following Friday Evening Discourses have been arranged by the Royal Institution to be delivered before Easter. The discourses begin at 5 o'clock: January 19, Sir Leonard Woolley, "The Latest Excavations at Atchana in North Syria"; January 26, Sir Noel Ashbridge, "Long Distance Broadcasting"; February 9, Prof. L. C. Martin, "Ultra-Violet and Electron Microscopy"; February 16, Sir William Bragg, "Physics in War-time", March 1, Lord Eustace Percy, "Peace-making after War: Past History and Future Problems"; March 8, Sir William Bragg, "Experiments from the Researches of Sir James Dewar"; March 15, Sir Frederick Keeble, "Agriculture and National Well-being".

Announcements

THE Harrison Lectureship Medal of the Pharmaceutical Society will be awarded to Mr. A. D. Powell at a meeting on January 9 at 7.30, when Mr. Powell will deliver the Harrison Memorial Lecture entitled "Drug Standards: their Development and Application".

THE next monthly meeting of the British Institute of Radiology will be held in the Reid-Knox Hall on January 19, at 2 p.m., when the following lectures will be delivered: Silvanus Thompson Memorial Lecture entitled "The Irradiation of Liquids", by Prof. F. L. Hopwood; Mackenzie Davidson Memorial Lecture entitled "Maternal Mortality and Radiology", by Dr L. A. Rowden.

THE Friends of the National Libraries decided at their annual meeting to continue their activities during the War. Acquisitions during the year included a number of early and rare books on science presented to the Science Library at South Kensington, a volume of drawings by the architect, Edward Blore, of country houses and other buildings, given to the Royal Institute of British Architects, and the purchase of a collection of papers belonging to the publishing business of Robert Cadell, Stoneham and Houlston.

THE Paris Academy of Medicine has awarded the Jansen Prize to Prof. A. Bessemans, pro-rector of the University of Ghent, for his work on spirochætes.

THE Albert Brachet Prize of 12,000 francs is awarded every three years for the best work on embryology published during this period in English, French, Dutch, German or Italian. Further information can be obtained from the Secrétarie perpétuel de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, Palais des Académies, Brussels.

THE Emergency Executive Committee of the International Congress of Mathematicians has decided definitely to postpone until some more favourable date the Congress which was to have been held in Cambridge in September 1940.

A EURASIAN YOUTH MOVEMENT has been launched in Singapore with a scheme to uphold and improve the social, moral, physical and intellectual welfare of the Eurasian youth when they leave school.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 73. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Anisotropy of Cellulose Sheet

IN view of the results just published by Spence[1] on the optical anisotropy of films prepared from various esterified celluloses, it may be of interest to record some recent measurements on 'Cellophane' (regenerated cellulose) sheet.

This material is observed to be optically bi-axial, the axes lying in the plane defined by the direction of extrusion and the normal to the sheet. The measurements made in this laboratory are not, as in Spence's case, direct measurements of birefringence, but are observations of the two principal refractive indexes in the plane of the sheet, and of the optic axial angle. From these the refractive index normal to the sheet and the birefringence have been calculated. Numerical results for two batches of material are given in the accompanying table, where θ is the angle between one optic axis and the normal to the sheet; n_γ is refractive index for electric vector along extrusion direction; n_β is refractive index for electric vector in plane of sheet at right angles to extrusion direction; and n_a is refractive index for electric vector along normal to sheet.

		θ	n_γ (obs.)	n_β (obs.)	n_a (calc.)	$(n_a - n_\gamma) \times 10^5$
Acid and water-washed sheet	Wetted	43·0°	1·418	1·408	1·403	−1000
	Air-dry	45·7°	1·534	1·526	1·519	−1500
Sheet undried during manufacture	Wet	56·5°	1·382	1·377	1·374	− 800
	Freely dried	57·6°	1·531	1·521	1·517	−1400
	Stretched and dried	72·3°	1·535	1·521	1·520	−1500

For ready comparison with Spence's birefringence figures, the values for $(n_a - n_\gamma)$ are given in the same units as used by him although, owing to the method by which the figures were obtained, they cannot have the same accuracy as his. They are not inconsistent, however, with the values to be expected—by extrapolation to zero acetyl content—from Spence's figures obtained on sheets prepared from cellulose acetylated to different extents.

It may be observed that, while the 'slow ray direction' and the direction of extrusion or stress are coincident in the regenerated cellulose sheet, Spence found them (with one exception) to be at right angles in sheets made from cellulose esters with various acyl groups. Moreover, in cellulose sheet, increase of the stress along the direction of extrusion leads to increase in the negative value of $(n_a - n_\gamma)$, in contrast again to the behaviour of the esters.

These differences are probably to be ascribed to the absence of acyl side chains in regenerated cellulose, since any 'selective' orientation that may be induced by stress will presumably have less effect on n_a and n_β in cellulose than in its esters. The values of n_a and n_γ in the material examined are nevertheless both increased by stress, while n_β remains remarkably constant.

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Heat Conductivity of Rubber at Low Temperatures

WHILST examining the possibilities of applying rubber in low-temperature work, we were hampered by the lack of available data of its physical properties at low temperatures. We were quite aware of the difficulties to be expected in making accurate measurements in that temperature region, and this applies specially to the heat conductivity in which we were particularly interested. In order to obtain at least an estimate of the order of magnitude, we carried out some measurements of the heat conductivity of commercial rubber (tyre rubber, North British) at room temperature and the temperature of liquid air.

We used (1) the standard method (heat transmission through a thin sheet) at both temperatures with a small vacuum apparatus which had a circular cross-section of about 7 cm.^{2}; the specimen had a thickness of 0·9 mm.; (2) we checked the low-temperature measurement by the following method. a bag of the same rubber was immersed in liquid oxygen and filled with liquid nitrogen. The rate of evaporation of the nitrogen was measured and, together with the dimensions of the bag, allowed of an independent determination of the heat conductivity. The mean values obtained by both methods are as follow:

T	293°K.	83°K.
cal./sec.cm.°K.	0·00055	(1) 0·000018
		(2) 0·000010

This considerable drop in the heat conductivity to, say, one fortieth from room to liquid air temperature does not seem to be confined to this particular rubber, as other specimens which we subjected to rough measurements show a similar behaviour.

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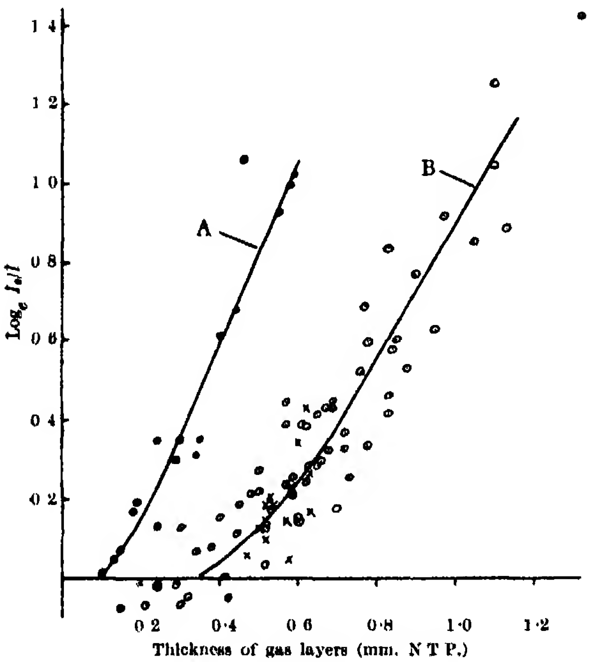
Absorption of Hydrogen Lyman Radiation by Atmospheric Gases

THE absorption of the hydrogen resonance line at 1215·7 A. has been investigated to obtain more exact information bearing on the theory of the production of short-wave radio fadeouts by solar eruptions[1]. The following results have been obtained:

(1) Nitrogen is transparent in layers up to 3·2 mm. thick (N.T.P.), in agreement with the early observations of Hopfield[2] and more recent measurements by Preston[3].

(2) Exact measurements on water vapour were difficult, but more than half the incident radiation is absorbed in a layer about 0·05 mm. thick. This agrees with Preston's observations.



●, oxygen, ○, air (energy in disruptive charge, 6 watts), ×, air (energy in disruptive charge, 3 watts).

(3) The absorption in oxygen and air was found to be much heavier than was expected from previous work. In the region where absorption commences, the densities of the parts of the hydrogen line in the absorption spectrum and the check spectrum without absorber, which was put on the same film, were compared directly as an approximate measure of the absorption. Lack of the characteristic curves for the emulsion should not cause serious errors in the comparison of nearly equal densities.

In the accompanying figure, Curve *A* shows the absorption of molecular oxygen in layers up to 0·6 mm. thick (N.T.P.). The ordinates are $\log_e I_0/I$ (I_0 being the unabsorbed and I the absorbed intensity); in the usual formula for mass absorption, $\log_e I_0/I = \mu x + c$. Since absorption appears to start only when there is a minimum gas layer amounting to about 0·10 mm., then c is not, in this case, zero. In addition, the absorption coefficient, μ, may not be constant for small values of the absorption.

Curve *B* shows the absorption in air. Several points falling below the axis of zero absorption indicate the possible magnitude of individual errors, and the general scatter of observations makes it difficult to define the absorption curve accurately. Its slope, however, is not constant, and again, there is no absorption until a minimum layer of gas is present. This minimum appears to be between 0·30 and 0·40 mm. (N.T.P.) and is not exactly five times the minimum in oxygen. For the strong bands at 1140, 1245 and 1450 A. absorption is clearly apparent in the least amounts of gas used for observations on 1215·7 A.

The absorption coefficients given for oxygen and air by Preston are about fifty times less. In the present case the absorbing gases were pure to within three parts in a thousand, and, in addition, water vapour, the most powerful absorber, was ruled out as an unobserved impurity by check experiments with saturated nitrogen. It is possible that Preston's observations were in error owing to serious dissociation of the oxygen in his apparatus (cf. the difficulties experienced by Ladenburg and van Voorhis[4]). In the present case reduction to half the energy dissipated in the discharge caused no observable difference in the absorption measurements, showing that dissociation of the oxygen was negligible.

With a fixed absorption path the pressure is varied in order to change the thickness of the absorbing layer, and it would appear from the two curves, therefore, that the partial pressure of the oxygen in the spectrograph is the factor determining the onset of absorption. This minimum pressure is about 0·04 mm. If absorption of 1215·7 A. is only possible when an oxygen molecule is in a slightly perturbed state owing to its collision with another oxygen molecule, the absorption coefficient should vary as the square of the pressure until the population density of absorbing molecules is constant. In oxygen at very high pressures, Shalow and Steiner[5] have found absorption bands which behave in this way, and attributed by them to the temporary formation of O_2–O_2 molecules.

If λ 1215·7 is emitted from the sun, no absorption will take place until it reaches levels in the upper atmosphere where the partial pressure of molecular oxygen is about 0·04 mm. (about 80 km.), except for attenuation due to the small amount of water-vapour above this height. According to the shape of the 'tail' of the absorption curve, the radiation would be absorbed more or less rapidly in dissociating oxygen molecules and producing ionization according to the process previously suggested[1]. The resultant ionized layer would perhaps correspond to that found by Budden, Ratcliffe and Wilkes[6].

This work has been made possible through a grant for research made by the Commonwealth Government.

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Does the Mesotron Obey Bose-Einstein or Fermi-Dirac Statistics?

WHETHER the mesotron obeys Bose-Einstein or Fermi-Dirac statistics is closely associated with what one assumes regarding the nature of the field, emission and absorption of which by the heavy particle is responsible for the interaction between elementary nuclear particles. If the field be a one-particle field, as postulated by Yukawa[1], the mesotron obeys Bose-Einstein statistics, and has a spin equal to unity (All momenta are expressed in units of $\hbar$) However, in view of the fact that all known elementary particles obey Fermi-Dirac statistics and possess a spin $\frac{1}{2}$, one is rather reluctant to accept, unless experimental evidence points that way, that the mesotron obeys Bose-Einstein statistics and has a spin equal to unity If we could suppose that the field involved is a two-particle field instead of a one-particle one, Fermi-Dirac statistics and a spin of $\frac{1}{2}$ could be attributed to the particle concerned. So we suppose that the mesotron is emitted or absorbed by a heavy particle always in conjunction with a neutrino or an antineutrino In symbols

$$P \rightleftarrows N + \eta^{+} + n^{-} \qquad (1)$$
$$N \rightleftarrows P + \eta^{-} + n^{+}$$

where N and P stand for a neutron and a proton respectively, n^{-}, n^{+} for a neutrino and an anti-neutrino, and η^{-}, η^{+} for the negative and the positive mesotron, which now obey Fermi-Dirac statistics and possess a spin of $\frac{1}{2}$

If we start with a neutron and a proton at r_1 and r_2 respectively, processes (1) obviously lead in the second approximation of the perturbation theory to an exchange interaction between the nuclear particles If we suppose that the spin of the heavy particle is not affected during (1), the exchange force is purely a Heisenberg force; if, on the other hand, the spin of the heavy particle is reversed during (1), we get a purely Majorana force, so that the correct spin dependence of nuclear forces is obtained by choosing for the interaction between the heavy particles and the mesotron-neutrino field a form which combines the above two.

The forces between like particles, which are known[2] to be of the same order of magnitude, for anti-parallel spins at least, as the force between unlike particles, can likewise be explained by introducing the neutral counterpart of the mesotron.

The phenomenon of β-decay can be fitted into this theory if it is assumed that the mesotron disintegrates into a β-particle and a γ quantum; so that the emission of a β-decay particle during a β-decay is accompanied not by a neutrino alone, as on Fermi's theory, but also by a γ quantum. This departure from Fermi's theory should enable us to explain in a more satisfactory way the energy distribution curve for the β-particle transformation.

Detailed calculations will be published elsewhere.

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Interpretation of Nebular Red-Shifts

IN a recent communication[1], M. E. J Gheury de Bray discusses the possibility of explaining the red-shifts by assuming that the velocity of light (c_T) is constant throughout the universe at any given time but decreases with time (T).

This hypothesis implies the assumption (a) that the atomic frequencies remain constant throughout space and time and may therefore be used as clocks (atomic clock 'AC') for time measurements; (b) that measuring rods, other than light years (which contract with a decrease of c_T), can be found For such measuring rods we may now choose the distances of *the material points* (for example, the nebulæ) in the universe, as according to the hypothesis the universe neither expands nor contracts Such measuring rods we call 'material rods' ('MR').

It shall be shown here that the proffered hypothesis, based on the measuring system $AC + MR$, is one of three alternative ways of formulating the hypothesis of the expanding universe

The following clocks and measuring rods can be taken as basis of a measuring system for cosmological purposes.

(a) Clocks	(b) Measuring rods
AC (atomic clocks), *or*	MR (material rods), *or*
LC (light-clocks the time taken by light over a given distance—c is here assumed as constant)	LR (light-rods, for example, light years the distance covered by light in a given time—c is here assumed as constant)

Only the following three combinations of these clocks and measuring rods can be taken as basis of a measuring system: $AC + MR$, which is the basis of Mr Gheury de Bray's hypothesis; $AC + LR$, a basis which leads to the expansion theory of the red-shifts, and $LC + MR$, which leads to what Milne[2] calls 'dynamical time scale', and to the 'speeding up' theory of the red-shifts.

($AC + LR$). The theory of the expanding universe states that the distances between material points, measured in LR, increase; in other words, it maintains an increase of MR against LR. This leads to the recession of distant nebulæ and to the Doppler effect. The identity of the frequencies of characteristic spectral lines throughout the universe (atomic clocks) is thereby assumed; the measuring system of the theory is thus the $AC + LR$-system. In tracing back the recessive movements it is found that $1 \cdot 86 \times 10^9$ years ago the size of the universe was zero. Thus an absolute scale of time T (based on the atomic clock) is assumed in which the unit is the (atomic) year and the *present value* of T is $T_P = 1 \cdot 86 \times 10^9$. (This 'age of the world' is confirmed by other measurements based on atomic radioactivity clocks.)

($AC + MR$). The above statement that MR increases if measured in LR is equivalent to saying that LR decreases if measured in MR. If MR is chosen and the clocks are not changed, the system $AC + MR$ is adopted. The decrease of LR means a decrease of the velocity of light (measured in MR). This permits an explanation of the red-shift of old light, since c_T was greater at the time $T - \Delta T$ when it was emitted and therefore $\lambda_{T-\Delta T}$ is longer than λ_T.

($LC + MR$). There is a third way to express the same facts. If we allow the light a longer time for its voyage, by defining our clocks in such a manner that they are slowing down as compared with the atomic clocks, then the decrease of c can be made to disappear. In other words, we adopt a new time scale τ in which the atomic frequencies throughout

the universe are speeding up; this explains the red-shift of old light.

The three alternative ways of expressing things agree in regard to the observable effects they describe. All predict the red-shift of old (distant) light. All therefore also predict a violet shift of characteristic spectral lines in the course of time to come (in $AC + LR$, that is, in the expansion theory, this has to be explained by an expansion of the spectroscope's grating). The three theories are logically equivalent, and therefore do not describe alternative *facts*, but the same facts in alternative *languages*. (To ask whether 'in reality' the universe expands, or c decreases, or the frequencies speed up, is not more legitimate than, when prices of goods fall throughout the economic system, to ask whether 'in reality' the value of money has increased or the value of the goods has decreased.) Nevertheless, the $AC + MR$-language seems to offer a particularly simple mathematical treatment and, furthermore, an *observational approach* to Milne's 'dynamical' time scale It shall therefore be briefly examined

In $AC + MR$, where characteristic atomic frequencies are assumed constant and c_T depends in some way upon T,

$$(1) \qquad (d\lambda/\lambda)_{T+\Delta T} = (\Delta c_T/T)_{T+\Delta T};$$

on the other hand, the observational law of red-shifts (velocity-distance relation) can be written:

$$(2) \qquad (d\lambda/\lambda)_{T_P-\Delta T} = (\Delta T/T)_P,$$

if the 'apparent distance' in light years, calculated on observed luminosities, is identified with ΔT. From (1) and (2) we get

$$(3) \qquad (\Delta c_T/\Delta T)_P = (dc_T/dT)_P = -(c_T/T)_P$$

Generalizing this and integrating we get the law of the decrease of c:

$$(4) \qquad c_T = c_P T_P/T.$$

If we proceed from $AC + MR$ to $LC + MR$, we have to introduce a time scale τ so that $c_\tau = c_P =$ constant. In order to get the general formula for $d\tau/dT$, we make use of (4), which can now be written as

$$(5) \qquad d\tau/dT = c_T/c_\tau = c_T/c_P = T_P/T;$$

integrating and choosing $\tau_P = 0$ (Milne chooses $\tau_P = T_P$), we arrive at

$$(6) \qquad \tau = T_P \log(T_\tau/T_P),$$

which is essentially Milne's formula (A)[2]; the index 'τ' in 'T_τ' indicates the value of T at the instant τ of the τ-scale. Equivalent to (6) is $T_\tau = T_P e^{\tau/T_P}$. From this and (5) we get the law of the 'speeding up' of characteristic frequencies when measured in $LC + MR$, that is, on the τ-scale:

$$(7) \qquad \nu_\tau = \nu_P dT_\tau/d\tau = \nu_P e^{\tau/T_P},$$

and from this and $c_\tau = c_P$ we get, corresponding to (2), the law of red and violet shifts in the form

$$(8) \qquad (d\lambda/\lambda)_{\tau+\Delta\tau} = -\Delta e^{\tau/T_P}/e^{\tau/T_P} = -\Delta T_\tau/T_\tau.$$

In the above deduction we have identified the 'apparent distance' (calculated on observed luminosities, that is, energy densities ρ, and not corrected for departures) with ΔT. Thus our assumption regarding ρ is that it measures the square of the *time* ΔT the light travels, which in $AC + MR$ cannot be identified with the ('real') *distance* r; for as the light was quicker when it was emitted, $r > \Delta T$. If the usual assumption that ρ measures not $(\Delta T)^2$ but r^2 is upheld, our deductions would have to be altered and we would neither get (4) nor its equivalent (6), that is, Milne's scale of τ. Vice versa, if our assumption regarding ρ is upheld and if we consequently arrive in $LC + MR$ at Milne's τ-scale, in which $r = \Delta\tau$, then neither r^2 nor $(\Delta\tau)^2$ can be taken as being measured by ρ. Whether this behaviour of ρ in τ can be deduced *a priori* in Milne's theory I do not know But available *empirical* data seem to speak at least not against our assumption that $(\Delta T)^2$—which is smaller than r^2—is a measure of ρ, for "present evidence points to observed luminosities (ρ) decreasing with distance *not even quite as rapidly* as we should expect. . . ."[3].

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"The Relationship between Pithecanthropus and Sinanthropus"

THE article by Dr. G. H. R. von Koenigswald and Prof. F. Weidenreich on the relationship between Pithecanthropus and Sinanthropus in NATURE of December 2 is eminently satisfactory to those anatomists who have not been able to understand why these two hominids should ever have been separated generically Probably my colleague, Dr. S. Zuckerman, was the first to express doubt on the justification for this distinction, in an essay on Sinanthropus[1], and I have on more than one occasion urged that the Peking hominid is but a Chinese variant of Pithecanthropus[2].

While for some years Prof. Weidenreich, with his first-hand knowledge of the Chinese fossils, has been insisting on their supposed distinctive characters, and has put forward the thesis that they represent an early type of man still more primitive than Pithecanthropus, he now agrees not only that Pithecanthropus and Sinanthropus "are related to each other in the same way as two different races of present mankind", but also that in some significant characteristics Pithecanthropus is the more primitive of the two. If these conclusions are accepted (as they certainly should be) it now becomes necessary finally to discard the generic term Sinanthropus. The Chinese fossils should logically be referred to the species *Pithecanthropus erectus*, or, if it should be thought more desirable as a temporary convenience for purposes of reference, they might be conceded a specific distinction with the name *Pithecanthropus pekinensis*.

The article of Dr. von Koenigswald and Prof. Weidenreich raises again the whole question of the validity of the morphological evidence upon which physical anthropologists often seem to depend for their taxonomic conclusions. For example, the authors use the remarkable argument that, because the femora ascribed to Pithecanthropus of Java show a marked degree of platymeria such as is not found in the femora of 'Sinanthropus', therefore they probably do not belong to Pithecanthropus. This statement would provide a pretty exercise in logical

analysis. A similar process of reasoning would also lead to the conclusion that, because a femur excavated from a Neolithic barrow shows more platymeria than the femur of a modern Englishman, therefore it cannot belong to *Homo sapiens*! In any event, an acquaintance with recent literature might have informed the authors of a short, but not unimportant, paper by the late Dr. Dudley Buxton on platymeria and platycnemia[3] in which evidence is adduced in support of the thesis that these characters may have a nutritional basis, and no racial significance.

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Oxford. Dec 17.

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Influence of the Geology of the Virgin Islands on Local Agricultural Practices

WITH the exception of Anegada, Santa Cruz, and part of Virgin Gorda, the Virgin Islands are hilly and rugged. There is in most cases a long narrow backbone rising to about 1,000 ft. with numerous lateral spurs sloping steeply to the sea. Owing to centuries of cultivation and charcoal burning, there is no virgin forest. The predominant vegetation is dense secondary bush in various stages of seral development. Many of the hills are stark naked, while others exhibit a sparse retrogressive xerophytic vegetation.

According to Earle[1] and Hardy[2], the islands are largely composed of enormously thick dynametamorphosed sedimentary tuffs lifted up from the ocean bed by volcanic forces To quote Earle: "The effect of these dynamic forces has been to lift the sedimentary beds bodily on end into a highly inclined position without obliterating the original stratification. These stratified metamorphic beds which cover by far the greater part of the presidency invariably strike East and West, which fact is doubtless responsible for the alignment of the islands in that general direction. They always dip very steeply, varying from 45° to 90° South and averaging 70°."

The tops of these highly inclined beds have frayed off and are scattered down the slopes in the form of flags of various sizes mixed with soil derived from them. This soil ranges from gravel to loam. The surface is thickly covered with denuded and weathered fragments. Such land at first sight appears extremely inhospitable. Yet owing to the scarcity of flat land, most of the cultivation is done on these talus slopes, which offer certain unique advantages.

After felling the secondary forest, the first step in the preparation of the land is the separation of flags from the soil. The disposal of the flags presents a problem which is easiest solved by placing them in rows along the contours. This is a common practice among the peasants. A few more alert individuals have made better use of the peculiar advantages to hand and have gone in for stone terracing out and out. Needless to say, all manner of terracing is seen, from the primitive arranging of stones in rows to admirable terraces.

To conclude, it will be seen that much of the land in the Virgin Islands can be stone terraced by the peasant himself at no cost apart from his labour. So far as I am aware, no inducement is offered to peasants in the British Virgin Islands to undertake such permanent improvement of their land.

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Dioximaleic Acid Oxidase Action of Peroxidases

Banga and Szent-Györgyi[1] recently described a new enzyme, dioximaleic acid oxidase, which catalyses the aerobic oxidation of dioximaleic acid to the corresponding diketo acid

It was shown in a previous paper[2] that hydrogen peroxide must play an important part in the mechanism of the ferment, because catalase inhibits the reaction between oxygen, ferment and dioximaleic acid completely.

We have undertaken preparations and purifications of the dioximaleic acid oxidases from different plant sources, such as *Rumex acetosa*, *Fraxinus excelsior*, *Prunus Padus*, *Syringa vulgaris* (leaves); horse-radish roots and cauliflower. Many different purification methods were used, as fractional precipitations with salts and organic solvents, absorptions, electrophoretic experiments and others. The removal of impurities by precipitation with lead acetate was especially successful in many cases. Thus the activity of the cauliflower juice was increased in one operation eight thousand times. Very high degrees of activity were obtained, that is, 40,000 c.mm. of oxygen per minute per mgm. of ferment from horse-radish. The

starting materials showed activities of 1 to 10. All of the purified preparations showed the typical peroxidase spectrum, 645, 550 and 500 mμ[2].

The ratio dioximaleic acid oxidase/purpurogallin number always remained practically constant in spite of all our attempts to separate the two activities from one another. Moreover, this ratio was nearly constant, whatever the source of the ferments. The purpurogallin number of the most active preparation from horse-radish was 900. The hæmatin content agreed with the figures of Elliott and Keilin[4]. Heavy metals other than iron were practically absent.

Determinations of the inhibitory effect of various reagents revealed remarkable differences between the dioximaleic acid and the purpurogallin tests. Hydrocyanic acid inhibits completely in the latter, incompletely and irregularly in the former. We think this irregularity, noticed first by Banga and Szent-Györgyi, must be connected with a strongly stimulating effect of hydrocyanic acid on the autoxidation of the dioximaleic acid with the subsequent formation of hydrogen of peroxides, which we have observed. Fluoride and azide inhibit in both tests though not to equal degrees, copper salts only in the dioximaleic acid test. Carbon monoxide inhibits only in the dioximaleic acid test. This inhibition is sensitive to light.

Heating ferment solutions to different temperatures caused qualitatively parallel inactivation in both tests.

The results mentioned indicated that the dioximaleic acid oxidase was a hæmin protein. Experiments with pure cytochrome c confirmed this conclusion[5]. We found previously[2] that cytochrome $c + 2\gamma$ of $Mn^{\cdot\cdot}$ were able to catalyse the oxidation of the dioximaleic acid.

We now find that manganese produces hydrogen peroxide by stimulating the autoxidation of the substrate. ($Fe^{\cdot\cdot}$-ions, but not $Cu^{\cdot\cdot}$, $Cr^{\cdot\cdot\cdot}$, $Ni^{\cdot\cdot}$ and $Co^{\cdot\cdot}$, stimulate the autoxidation, but practically no hydrogen peroxide remains in the solution, as it is removed by a secondary, peroxidatic reaction between $Fe^{\cdot\cdot\cdot}$, hydrogen peroxide and dioximaleic acid.) Thus the manganese can be entirely replaced by the addition of a small amount of hydrogen peroxide. The hydrogen peroxide, which does not disappear during the reaction, seems to take part as well in the reduction of the $Fe^{\cdot\cdot\cdot}$ as in the oxidation of the $Fe^{\cdot\cdot}$. Analogous mechanisms have been proposed for the catalase[6]. The cytochrome remains mainly reduced until all of the substrate is oxidized. Then the cytochrome is immediately oxidized and partly destroyed by the hydrogen peroxide. Manganese or hydrogen peroxide can be replaced by hydrocyanic acid, which stimulates the hydrogen peroxide production and does not inhibit the reaction because cytochrome c gives no compounds with hydrocyanic acid at this pH. We have here interesting examples of hydrogen peroxide maintaining, or hydrocyanic acid stimulating, a hæmin protein catalysis.

On the basis of the experiments described above, the possibility was considered that the natural dioximaleic and oxidase could be identical with the peroxidase. However, its manner of reaction in the dioximaleic acid and in the purpurogallin test might be different. In the latter the peroxidase is supposed to remain all the time in its ferric state[3]. In the former, on the contrary, we were able to demonstrate the reduction of the ferric to the ferrous state. If solutions of peroxidase preparations plus dioximaleic acid are shaken with air the colour turns from brown to red with absorption bands appearing at 580 and 545 mμ, belonging to the $Fe^{\cdot\cdot\cdot}$-hydrogen peroxide-peroxidase II[3] or to a hypothetical $Fe^{\cdot\cdot}$-oxygen-peroxidase, or to a mixture of both. If the air is rapidly replaced by carbon monoxide the bands of the $Fe^{\cdot\cdot}$-carbon monoxide-peroxidase (578,543) appear. Thus a valency change, ferric $\rightleftarrows$ ferrous, is involved in the reaction of the ferment with dioximaleic acid, but not with hydrogen peroxide plus pyrogallol.

The differences found in the experiments with inhibitory substances thus may be explained, and there is no sufficient reason for the assumption that the dioximaleic acid oxidase and the peroxidase are different ferments. Our results give an example of a ferment, acting in a different manner with different substrates. They also show that the characterization of ferments exclusively on the basis of the effect of inhibitory reagents may lead to mistakes. Differences may be due to the substrates and not to the ferments themselves. Finally, the dioximaleic acid is remarkable because it allows the peroxidase to produce the necessary hydrogen peroxide spontaneously. A detailed report will be published elsewhere.

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Dec. 7.

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[6] Weiss and Weil-Malherbe, NATURE, **144**, 866 (1939), with further literature references.

Diurnal Rhythms in the Axolotl Larva and in Drosophila

DURING spring and summer of this year, I made some experiments with the intention of throwing light on the physiological mechanism of diurnal activity rhythms. An account of some of the main results follows. It is hoped to publish full details of the experiments at a later date.

The motor activity of axolotl larvæ was recorded by means of a simple actograph. The animals were kept in a shallow layer of water. Their activity caused movements of the water surface, which were recorded on a slowly moving smoked drum, by means of a float connected with a light lever.

The larvæ showed a pronounced diurnal rhythm, under normal conditions of alternating daylight and darkness, being more active at night. If the larvæ were put in continual darkness, the rhythm persisted. If, however, they were subjected to alternating illumination and darkness, so controlled that the illumination phase was made later and later by gradual stages, the rhythm could be reversed. The animals were then active during the real day (this was by now the dark phase) and quiet at night (the artifically lighted phase). Evidently, the rhythm is primarily determined by light; but there is also an inherent rhythm revealed by the persistence of activity cycles in continual darkness.

I was unable to detect any diurnal activity rhythm in metamorphosed individuals.

Hypophysectomized larvæ are active by night and quiet by day, like normal ones; but only so long as the normal illumination cycle acts upon them. In continual darkness, the distribution in time of their activity at once becomes quite irregular. Thyroidectomy does not interfere with the activity rhythm. It appears then that the hypophysis plays an important part in the inherent rhythm revealed by normal animals kept in darkness.

The interrelations of internal and external factors in determining diurnal rhythms were also studied in Drosophila. Here a 'hatching rhythm' appears. Under normal lighting conditions, most of the adult flies emerge from the pupa in the hours just before sunrise. The interval between consecutive 'emergence peaks' is always twenty-four hours, whatever the temperature, and it appears that light is the primary controlling factor. If the culture is transferred to continual darkness, the rhythm continues unmodified at medium temperatures. At low temperatures the intervals are slightly lengthened, at high temperatures shortened.

By altering the temperature, the intervals between emergence peaks were varied between 2½ days and 16 hours. The 'inherent rhythm' revealed by the persistence of emergence maxima in darkness is therefore sensitive to temperature. It appears to have a temperature coefficient obeying van't Hoff's rule.

If a culture is kept from the first in continual darkness, no hatching rhythm appears. The rate of emergence is affected by temperature; less flies than usual emerge during and just after a rise, and more during and after a fall. However, temperature change does not induce a persisting rhythm. Light, on the other hand, can induce such a rhythm. One single illumination period, provided that it lasts for at least 4 hours, induces a 24-hours rhythm in a culture kept beforehand and afterwards in continual darkness. The temperature relations of the rhythm thus induced are as follows: (1) whatever the temperature at the time of illumination, the rhythm has a period of 24 hours, provided that the temperature does not afterwards change; (2) subsequent change has the usual effect (lower temperature slows, while higher temperature hastens, the rhythm). The fact that a 24-hour rhythm can be induced by a single illumination period, independently of temperature, is remarkable and the nature of the factors ensuring that the induced rhythm shall have a period of 24 hours remains, for the present, obscure.

The experiments were carried out in the Department of Zoology, University College, London. I wish to thank Prof. D. M S. Watson for kindly allowing me to work in his Department, Mr. C. P. Wells for much helpfulness, and Mr N. H. Howes for allowing me to use his intact and operated axolotls

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Points from Foregoing Letters

REGENERATED cellulose sheet is shown by D. G. Drummond to be birefringent in a way which might reasonably be expected from extrapolation of Spence's results for sheets made from cellulose esters. The relative unimportance of side-chain orientation in cellulose itself results in a generally greater birefringence and a change in the 'slow ray direction' as compared with the ester films. Numerical results for regenerated cellulose sheets are given.

A. Schallamach finds that the heat conductivity of commercial rubber at the temperature of liquid air is about one fortieth of that at room temperature.

S. E Williams has examined the absorption of the hydrogen line at 1215·7 A. in nitrogen, water vapour, oxygen and air. Nitrogen is transparent and water vapour absorbs very strongly. Oxygen and air absorb much more strongly than has previously been believed. No absorption appears to occur until the partial pressure of oxygen is about 0·04 mm., and the absorption coefficient varies in the lower part of the absorption range. If the emission of 1215·7 is responsible for short-wave fadeouts, the radiation will penetrate to about 80 km. before it is absorbed in producing ionization.

Making the assumption that the field responsible for the interaction between elementary nuclear particles is a two-particle field, so that a mesotron is always emitted or absorbed in conjunction with a neutrino or antineutrino, P. L. Kapur states that it is possible to derive the forces between the particles and to explain the phenomenon of β-disintegration.

That the three theories (1) the universe expands, (2) c decreases, (3) atomic frequencies speed up, are all equivalent and must not be looked upon as alternative explanations is stressed by K. R. Popper The systems of measurements underlying these theories are compared and an observational approach to Milne's 'dynamical' time is mentioned. It is asked whether in (2) and (3), luminosities do not decrease with time (measured in frequencies) instead of distance.

Now that it is admitted that Sinanthropus is but a variant of the Pithecanthropus type, W. E. Le Gros Clark suggests that the generic term Sinanthropus should be discarded. The Peking fossils should be referred to the species *Pithecanthropus erectus*, or at the most they might be conceded a specific distinction with the name *Pithecanthropus pekinensis*. The argument that the femora ascribed to Pithecanthropus of Java do not really belong to this genus has no logical basis.

F. A. Squire states that, owing to geological peculiarities, the soils of the Virgin Islands are composed largely of flags. This makes stone terracing a practical, inexpensive proposition

B. Swedin and H. Theorell have extracted and investigated the ferment recently described as new and called dioximaleic acid oxidase by Banga and Szent-Györgyi. From their observations, Swedin and Theorell conclude that this ferment is a hæmin protein and that it can act in a different manner with different substrates. They finally conclude that there is not sufficient reason for the assumption that the dioximaleic acid oxidase and the peroxidase are different ferments.

H. Kalmus describes experiments on the physiology of diurnal rhythms in axolotl larvæ and Drosophila, dealing with the relation between externally and internally determined rhythms, the action of light, temperature and endocrine factors.

RESEARCH ITEMS

Australian Shell Ornaments

A DETAILED study of shell ornaments in use by the aborigines over wide areas in Australia has been made by C. P. Mountford and Alison Harvey, ethnologists of the South Australian Museum (*Records S. Austral. Mus.*, 6, 2, 1939) These shell ornaments fall into two divisions, one made from the baler shell (*Mela diadema*) and the second from the shell of the pearl oyster (*Meleagrina maxima*) and the smaller pearl shell (*Meleagrina margaritifera*). The pearl shell ornaments are found almost exclusively in western Australia, while with a few exceptions the baler shell ornament is limited to Queensland, Western Central Australia and north-eastern South Australia. The pearl shell ornaments are used for decoration and as objects of ceremonial importance. For the former purpose they are suspended from a belt back and front, while both men and women wear several down the back suspended from a necklace of human hair. In Central Australia the chief aspect of their magical purpose is their potence in charms for women and their healing properties. Various myths are woven round the pearl shell, and a particular chant is sung when the designs, which appear on them, are being engraved The ornaments are oval in shape and vary from two to eight inches in length. The baler shell ornaments vary in use according to locality; but they may be used as ornaments or for ceremonial purposes. In west-central Queensland, for example, they are used for personal adornment or as a decoration on the haft of a spear-thrower. Among the Dieri, however, the shell ornament had great magical value and was closely connected with the circumcision ceremony, in which it was worn by the initiate as a chest ornament. The Dieri were also the only tribe using the shell for evil magic. In appearance the ornament was an ovate piece of white shell from two and a half inches to five inches long. Designs were engraved on the concave face and red ochre rubbed in. These shell ornaments were intended for male use only, but in certain circumstances, more or less ceremonial, women were allowed to handle or use them

Scaphocephaly among Australian Aborigines

IN an examination of 2,000 skulls of Australian aborigines, Frank J. Fenner, honorary craniologist of the South Australian Museum, has found five cases of scaphocephaly (*Records S. Austral. Mus.*, 6, 2; 1939). Two forms of scaphocephaly are recognized, of which one is descriptive of the form of skull characteristic of the Eskimo, and found among the Australian aborigines, and the second is pathological —a premature, probably fœtal, synostosis of the sagittal suture present in a very long narrow type of skull; this is a rare condition occurring in many races, European, Egyptian, Negroes, etc. The specimens here described belong to the second class. Premature closure may, of course, occur without any trace of scaphocephaly. Of the skulls examined three were adult (male) and two juvenile, 4–5 years and 6 years. Detailed observations and comparisons with such normal material as was available were made. In the result these observations would go to support the conclusion of Hamy that scaphocephaly is the result of the synostosis of the two parietal bones, that this synostosis is the result of a pathological process, probably inflammatory, and that the deformation occurs only when the fusion begins during intrauterine life at a time close to the commencement of the ossification of the cranial vault. In two of the skulls and in one described in 1867, fine vascular pores covering the surface of the bone gave evidence of a pathological condition. Three of the skulls examined showed a synostosis of the squamous suture, but of 1,200 normal aboriginal skulls, three only showed fusion of the squamous suture—all aged individuals. Probably this condition is here related to the sagittal synostosis and an outcome of the same underlying pathological cause.

Doubling the Chromosomes of Nicotiana

H. E. Warmke and A. F. Blakeslee (*J. Hered.*, 30, 419–432; 1939) have successfully induced the doubling of chromosome numbers in *N. Sanderæ*, *N. Tabaccum* × *glutinosa*, and *N. glutinosa* × *N sylvestris*, by treating with colchicine. Treatment of seed gave as high as 100 per cent tetraploids of *N. Sanderæ* A new method of application by using an emulsion spray, consisting of stearic acid, morpholine and lanolin, has been found more efficacious than the water spray. It is noteworthy that mixtures of fertile and sterile flowers on one plant were not obtained from seed treatment, but the whole plant was either diploid or tetraploid in behaviour. On the other hand, stomatal size in these plants was not always correlated with fertility. This indicates that some of the plants may have been periclinal chimæras.

The Chrysanthemum Midge

A MINUTE, red, two-winged fly which produces small conical galls upon the leaves and stems of chrysanthemums has been recognized as a serious pest in the United States, and has appeared twice in Great Britain during the last decade. The present attack is, fortunately, somewhat limited, but Dr. H. F. Barnes has published a timely description of his studies of the insect (*J. Roy. Hort. Soc.*, 64, Pt. 2; Nov. 1939). The midge, which has usually been recorded as *Diarthronomyia hypogæa*, infests commercial late-flowering chrysanthemums, but will not apparently spread to the earlier summer kinds, nor to common, closely related weeds. Five generations appear every year in cool greenhouses, but in heated structures there are eight. The length of time spent in each stage of the life-history appears to depend directly upon temperature, being generally shortened by summer heat. Severely infected plants do not flower. Consistent spraying or fumigation with nicotine provides a complete, though very expensive, control. The most effective prevention, however, is the cutting of infected shoots to ground-level, for the stool cuttings which emerge later from such plants are found to be free from the insects.

Larvæ of British Coleoptera

IN the *Entomologists' Monthly Magazine* of November and December, Dr. F. van Emden, of the Imperial Institute of Entomology, contributes the first of a series of articles on the larvæ of British Coleoptera (beetles). The object of these contributions is to provide keys to enable the larvæ of the

British members of the order to be recognized as reliably as possible, and the first of these articles deals with the family Cerambycidæ. The material upon which the account is based consists primarily of that available in the collections of the British Museum (Natural History). Important additions, however, were based upon the specimens obtained on loan from the Zoological Museum, Copenhagen. All the thirty-six genera of British Cerambycidæ are included in these keys. Seven of the genera, however, have their characters taken from literature, since no larval material was available. While it will obviously be a lengthy business in dealing with the larvæ of even the chief families of British Coleoptera, the present account is a good beginning, and we hope to see many other groups similarly treated by Dr. van Emden.

Control of the Bean Rust Fungus

A RUST disease of the bean is widely distributed in Lower and Middle Egypt, and its control has formed the subject of a study by Dr. A. F. El-Helaly (*Min. Agric. Egypt, Tech. and Sci. Serv. Bull.* 236. Govt. Press, Bulâq, Cairo, P.T. 4. 1939). Spraying with Bordeaux mixture of half per cent strength was found most effective, and yielded the significant net profit of from one to four Egyptian pounds per feddan. Chocolate spot, caused by *Botrytis fabæ*, was also controlled by the same treatment. Sulphur fungicides were tried, but were not found reliable against these particular parasites, and the Bordeaux treatment possessed the further advantage that no physiological check was administered to the foliage.

Vertical Air Currents

SCIENTIFIC Note No. 81 (7) of the India Meteorological Department, by K. P. Ramakrishnan, deals with vertical currents in the first few kilometres over Poona and their possible effect on the measures of upper winds made by pilot balloons assumed to rise at a known constant rate. The vertical currents were deduced from the height-time curves found for balloons by the tail method, which involves measurements of the angle subtended by a tail assumed to hang vertically beneath the balloon, with the aid of a special graticule in the pilot balloon theodolite. The method is probably accurate enough for the purpose of revealing vertical currents of the strength of those often observed at Poona in the hot season. A more serious source of error in computing the vertical currents arose from the assumption that the differences between the observed rate of ascent (V) and the rates given by the standard formula $V = q\frac{L^{1/2}}{(L+W)^{1/3}}$, where q is a constant for a particular size of balloon, L is free-lift and W is weight of balloon, are measures of the vertical currents. Actually, the rate of ascent of a balloon is affected by its shape, which is never truly spherical, and, to judge from the performance of the 100-gm. Dewey and Almy balloon, by other factors not yet understood, for with this balloon, so far as observations have been made at the Meteorological Office, the rate of ascent varies roughly as $\frac{L}{(L+W)^{2/3}}$, and not as the square root of that quantity, as is implied by the standard formula. Such sources of error probably do not invalidate two of the conclusions reached by Ramakrishnan; first, that the rate of ascent of a balloon for a given lift and weight is far more variable in the afternoon than in the morning at Poona, and that this is due to the greater magnitude of the vertical currents in the afternoon, and secondly that a method of obtaining upper winds that involves the assumption of a constant rate of ascent of the balloon is thoroughly unreliable in a tropical climate like that of India. The values of vertical velocity found were mostly between 3 km. and 5 km./hour in the afternoon, and occasionally reached 10 km./hour.

Geography of Egypt

A VOLUME entitled "Contributions to the Geography of Egypt", written by J. Ball (Cairo: Government Press. 10*s*. 6*d*.), may be regarded as a comprehensive study of most aspects of the Nile and contains a great deal of new matter as well as facts that are scattered in various publications. Apart from the treatment of the physical aspects of the Nile basin and water, the Faiyum depression is the subject of a lengthy study. Much has already been written on this lake. Dr. Ball points out that the absence of Pliocene deposits proves that the depression cannot have been in existence in those times. The numerous lacustrine deposits of later ages show that a lake of varying height must have existed from early Pleistocene times to the present day, and since there can have been no erosional deepening of the depression while the lowest part was below the surface-level of the lake, its excavation must have been entirely accomplished between the end of the Pliocene and the beginning of the Pleistocene. But the Nile then flowed at much higher levels than to-day, so that its lateral stream could not have effected erosive action at such low levels. Thus, argues Dr. Ball, the Faiyum was hollowed out independently of the action of the Nile: some other agency must have been at work. He concludes that the depression is due to wind erosion in early Pleistocene times, and this theory is supported by what is known of the origin of other depressions in the Libyan plateau such as the oases of Kharga, Dakhla and Qattara.

Drainage of Southern Ireland

THE peculiar trellised pattern of the river system of southern Ireland has attracted considerable attention since Jukes postulated a superimposed origin from an elevated initial surface. Hull modified this hypothesis by invoking fault lines as controlling the right-angled deflections of the rivers. Austin Miller has re-examined the whole problem in a paper entitled "River Development in Southern Ireland" (*Proc. Roy. Irish Acad.*, 45, Section B, No. 14). One of the most difficult features to explain is the failure of the subsequent at the expense of the consequent rivers in the completion of the pattern which might be expected to have led to the outflow of the Blackwater to Dungarvan Bay and the Lee to Youghal Bay. Conditions appear to favour this completion, for there has been rejuvenation since the present mouths were acquired that would provide the subsequents entering these two bays with the increase in gradient necessary for headward encroachment. Mr. Miller suggests that the explanation lies in the acquisition by the present estuaries of a volume of discharge, by a long process of captures, so much greater than that of their competitors that they have been able to excavate sufficiently rapidly through the hard ridges that attempt to bar their courses and so outrival the strike streams in spite of the softer rock over which the latter flow.

AIR TRANSPORT, INSECTS AND DISEASE

BY DR. A. D. IMMS, F.R.S.

MR. F. G. SAREL WHITFIELD has recently issued a comprehensive article on air transport, insects and disease (*Bull Entomol. Res.*, 30, 365–442; 1939). The discovery by Shannon in 1930 of the presence of *Anopheles gambiæ*, an insect native to Africa, in the city of Natal, Brazil, and its subsequent spread, directed special attention to the carriage of disease-bearing insects by aeroplanes. Whether *A. gambiæ* was actually transported in a surface vessel or in an aircraft will probably never be known, but, as the result of its entry and subsequent spread, more than 90 per cent of the population around Natal were infected with malaria in 1938. The indexes of malaria-infected mosquitoes are said to be the highest in the history of malaria. The introduction of *A. gambiæ* into South America seems to have had the disquieting results, just referred to, because possibly the native population has very little power of resistance to the African strain of the disease carried by the mosquito.

The situation as regards yellow fever is potentially far more serious than that concerning malaria. Shannon, Whitman and Franca in 1938 made a significant contribution to what is known of the vectors of yellow fever. They produced positive evidence of the mosquitoes *Aedes leucocelænus* and *Hæmogogus capricorni* being concerned in the transmission of jungle yellow fever in Brazil. Until this discovery, evidence of any mosquito other than *Aëdes ægypti* being implicated in the transmission of yellow fever was furnished solely on the results of laboratory experimentation. The aspect of most importance with regard to aerial transport, arising out of recent research on yellow fever epidemiology, seems to be the discovery of vast areas in Africa and South America where the disease prevails in epidemic or endemic form. It is obviously of prime importance that aircraft operating within and from Africa and South America should be maintained free from all insects. Mr. Whitfield points out that the proposed reserve Empire war route across Africa to India and Australia will present an urgent problem in this connexion, and that it would be unwise to inaugurate such a service until the proper control of insects in aircraft has been achieved. In view also of the proved existence of considerable insect populations in the upper air, the question of the possibility of aircraft collecting insects while in flight arises. The ability of insects to survive air transit is another problem. *Aedes ægypti*, for example, has been proved to be able to endure a journey of at least 9,580 miles in length and of 6½ days duration.

Diptera are overwhelmingly the commonest insects found in aircraft. Species of Musca are very frequent and also many kinds of mosquitoes. The control of insects in aircraft is a difficult subject. As Mr. Whitfield remarks, it involves the co-operation of the entomologist, the chemist and the engineer, an airline operating company and a commercial aircraft manufacturer. Such joint approach to the problem, he holds, is essential if progress is to be made. No adequate and reliable method of control of insects in aircraft has yet been devised: the problem of controlling insect invaders of aerodromes needs also the fullest attention. Little will be gained, the author adds, from further research upon insects found in aircraft—the real problem being the effective means for their destruction.

THE ROTHAMSTED EXPERIMENTAL STATION

BY E. J. ROBERTS

THE annual reports of the Rothamsted Experimental Station are of more than ordinary interest to farmers and research workers. The amount and variety of the fundamental investigations carried out in the laboratories, linked with the field work not only at the Rothamsted and Woburn farms, but also at a number of commercial farms scattered over England, give these reports a character and importance of their own. The improvements in the technique of field experimentation, evolved at the statistical department, have not only given more accuracy to the usual trials, but also have widened the scope of investigations by making it possible to detect small differences, and to measure, for example, the interaction effects of certain manures.

In the report for 1938*, published recently, an account is given of the experiments on wheat, including those on the continuous growing of this crop, and those on the value of leys, green manures, and fallows for preceding the wheat crop. The experiment on the continuous growing of wheat has now been in progress for nearly a hundred years, and it is interesting to note that the land has not become what might be termed 'wheat-sick'; the main difficulty has been in the suppression of weeds rather than in the actual growth of wheat. This conclusion is important at the present time. Why, it is asked, when these experiments prove clearly that wheat can be grown continuously on the same land, should difficulties arise when the crop is grown for a few years in succession on certain mechanized farms? An explanation is offered to the effect that the nature of the soil is responsible. Wheat is a heavy-land crop, and, on the heavy Broadbalk soil, the crop remains healthy; diseases and pests are present; but they do little damage. The lighter soils, however, especially the light chalky soils on which many mechanized farms are situated, are more liable to

* Rothamsted Experimental Station, Harpenden. Report for 1938. (Harpenden: Lawes Agricultural Trust.) 5s.

contain diseases, such as take-all, lodging diseases and others, and the crop suffers more heavily.

The effects of temporary leys, green manures, and fallows as preparation for wheat are also under investigation, and the field trials are combined with work in the chemistry department to follow seasonal changes in nitrates, ammonia, and readily decomposed crop residues in the soil; an attempt is made to trace the form in which available nitrogen is carried over from one year to another.

Sugar beet is the subject of extensive investigations carried out on a variety of soils, in conjunction with the sugar factories; the extent of these experiments may be judged from the fact that, in 1938, there were 38 experiments, with 1,360 plots. These experiments are mainly concerned with manurial responses in the various soil groups. The year 1938 was disappointing as regards this crop, the yield, expressed in terms of sugar, having been 12·5 cwt. per acre less than the average of the previous four years.

Other long-term experiments recorded are those on organic manuring by means of green crops, town refuse and straw. The question of organic manuring, and of the use of town refuse in particular, is of more than ordinary interest to-day. It is interesting to note that a prepared town refuse gave encouraging results in a comparison with sulphate of ammonia, dung and rape dust. The refuse gave rather higher yields than farmyard manure providing equal nitrogen in three out of four comparisons, and did almost as well as sulphate of ammonia providing half as much nitrogen.

Other sections of the report also contain much of interest, for example, those on the farm, and the report on fungus diseases at Rothamsted and at Woburn. Details are given of the experiments at outside centres. It is interesting to observe that in such experiments, which are designed at the Station, the degree of precision compares favourably with that in the experiments carried out at Rothamsted and Woburn.

ELECTRICITY SUPPLY IN AUSTRALIA AND NEW ZEALAND

THE rapid expansion in the practical applications of electricity in parts of Australia and New Zealand and the new problems to which it gives rise is well illustrated in the *Electrical Times* of November 23. In England we consider a 'County Council' as a body which has definite connexions with general public services as, for example, health, education, highways and the like. This is not the case at Sydney, New South Wales, where the 'Sydney County Council' was created in 1935, by a special Gas and Electricity Act, which enables it to assume ownership and control of the electricity department which up to that time had been in the hands of the City Municipal Council. This County Council has only five members, two of them elected by the City Municipal Council and the remaining three being shared by the municipal councils of thirty-two other townships. For election as a councillor, the candidate must be qualified by being eligible for aldermanship in one of these constituencies. This arrangement has points of similarity with that of our own Joint Electricity Authorities (J.E.A.). The Sydney County Council supplies electricity directly to the public in the city, thirty-two suburbs and for street lighting in the city. In addition it gives a bulk supply to fourteen other municipal authorities who do their own distribution, and to a company which distributes to two other municipal areas. The area throughout which a direct supply is given is about 150 sq. miles and its population is about 900,000. The 'bulk' areas are about 750 square miles and have about 150,000 inhabitants. Altogether the County Council supplies electricity over an area of approximately 900 sq. miles and having more than a million inhabitants.

The County Council co-operates with the railway department, which has a supply station of its own so as to level the output and so cheapen the cost. The interchange of energy between them is adjusted so as to be nearly equal at the end of each quarter. The main business of the County Council's Electricity Sales Branch is three-fold: first, to develop and advertise the use of electricity in commerce, industry and the home, secondly to sell electrical apparatus and thirdly to deal with contracts for large supplies of energy. The sale of apparatus, ranges, water-heating systems and wash-boilers is arranged for cash or on hire purchase. Instantaneous heaters are sold for cash only. The installation work is also sold by the Council. Two forms of merchandizing are employed. In one the Council buys the equipment and sells it to the consumer. In the other the Council sells the apparatus for the supplier on a commission basis. The basis of the Council's service policy is "make friends with the consumers. This is effected by the advisory service, which not only develops the use of electricity but keeps the consumers satisfied".

Reports from the New Zealand municipalities, which largely utilize hydro-electric power, show that there is considerable anxiety in both North and South Islands as to how to meet the coming winter loads. Deputations have approached the Government and pointed out the limitations of the hydro-electric power available and the urgent need of steam-driven plant to cope with the expected peak load of 1941. The general manager of Christchurch Electricity Department ends his report with these words: "The city of Christchurch is now so completely dependent upon electricity supply in its public services, which include sewerage and water pumping, that the electricity supply intimately concerns hygiene and health as well as the general public life". It looks as if in a few years' time these words would apply to many cities spread over the whole world.

The electrical engineer of Dunedin says that they cannot always count on getting the same ample supply of water-power every year. In severe frosts in winter time very little water-power may be available. The great demand for instantaneous water heaters for baths shifts the maximum load from the afternoon to the early morning. This makes it difficult to devise an equitable multi-tariff meter system which will charge the consumer most at times when the load is a maximum at the supply station.

PALÆOLITHIC MAN IN THE NORTH MIDLANDS

NOW that the text of Mr. A. Leslie Armstrong's Wilde Memorial Lecture is available in full (*Mem. and Proc. Manchester Lit. and Phil. Soc.* 1938–39, 83, 1939. Separate, pp 30, with plates. Price 1*s*.), the results of the investigations summarized in that lecture call for more extended notice than was possible at the time of its delivery on March 14 last (see NATURE, 143, 512 ; 1939). As Mr. Armstrong pointed out, the North Midland area, that is, the Trent basin north of Leicester, has yielded evidence which now makes it possible to demonstrate on a stratigraphic showing the presence of man here during every stage of the palæolithic period more completely than for any other part of England

An important consideration, which Mr. Armstrong emphasized in the opening of his lecture, was the constant oscillation in climatic and environmental conditions during the Ice Age, while at the same time he dwelt on the distinction worked out in detail by the Abbé Breuil between the core culture peoples associated with inter-glacial periods and the flake culture races associated with glacial periods. The changing environment not only brought about racial movement, but also necessitated cultural development and the elaboration of new types of implements, although with the setting in of less favourable conditions once more old and traditional types at times were revived.

Mr. Armstrong's evidence was drawn in part from recent explorations of the Trent Valley gravels, still in progress, in part from his now well-known investigations in Yorkshire and Derbyshire caves and on certain sites in Lincolnshire

LOWER PALÆOLITHIC AGE

The first record of Lower Palæolithic implements in the Trent Valley was made in 1928 in a gravel pit at Burton. Further investigation by Mr. Armstrong and others has now shown that all the recognized forms of both the core and the flake industries from Pre-Chellean to Mousterian occur here. These finds come from three horizons of gravel, comprising two old river-terraces and a high-level glacial gravel. The main interest of the investigation, therefore, lies not merely in the occurrence of this range of types here, but also in the correlations which it has made it possible to attempt.

Recent investigation has also determined that the gravels, though they have been described as "Old Valley Gravels", are actually of sub-glacial origin. The low terrace comprises the infilling of an ancient valley of which the floor lies far beneath the bed of the Trent and through which that river has cut its channel. The most important deposits of the series are the high-level gravels, which mantle extensive areas on both sides of the valley. In the deposits three zones are distinguished, of which A, the oldest, in certain of the Hilton sections, rests upon bed-rock, the Keuper marl, while in others it thins out until B rests on that rock. In other sections B and C zones, separated by a band of sand in gravel particles, alone are present.

As regards archæological content, artefacts found in Zone A *in situ* fall into two well-defined groups, of which the first, consisting of pre-Chellean, Chellean and a Levallois flake are patinated a deep chocolate-brown, heavily rolled and evidently derived from an earlier deposit ; while the second is patinated bluish-white and appears to be contemporary with the gravel. In the latter group were a typical Acheulean hand-axe, as well as a late Clactonian (or Tayacian) flake and two slightly rolled Levalloisian flake tools. The contents of Zone B, though less numerous, are the same as in A, but differ materially in condition. All are heavily rolled, but some Levallois and Clacton types are only slightly abraded. The patination suggests that the abraded artefacts are derived from Zone A.

Zone C exhibits extreme contortion, suggesting lateral pressure, or collapse under the influence of melting snow and ice. It has not yielded any Acheulean types, but two heavily rolled Clactonian and a Levalloisian flake, both only slightly abraded and, therefore, possibly contemporary with the gravels, have been found. The latter are important for correlation purposes.

For these conditions certain tentative interpretations are put forward by Mr. Armstrong. In the first place, he suggests that the co-existence here of core and flake may be due to the fact that they are not, as concluded by the Abbé Breuil, two distinctive cultures, but two techniques ; and in that event, while the flake industry was indeed almost exclusively employed by the ancestral Mousterian race, Acheulean and later peoples may have employed Clactonian and Levalloisian techniques where necessary or expedient. Secondly, that Zone A represents a deposit laid down at the end of the great Acheulean inter-glacial—possibly a remnant of the Little Eastern glaciation equated with Würm—which has been ploughed away and incorporated in Zone B. Thirdly, that Zones A and B respectively correspond with the two glacial phases separated by an interglacial phase, associated with a Mousterian (Late Clactonian or Tayacian or Micocquean in its earlier phase) observed in the Pin Hole section, Cresswell Crags. Fourthly, Zone C may be either a melt-out of Zone B, or a local re-advance of the ice after the B stage, or the final glaciation (Hessle) of the northern region.

MIDDLE PALÆOLITHIC AGE

In dealing with the Middle Palæolithic Age, Mr. Armstrong's evidence is chosen entirely from the cave explorations on which he has been engaged with the assistance of a Research Committee of the British Association for more than thirteen years. The Pin Hole Cave, Cresswell, has given a type cave section for Britain with occupation ranging from Mousterian I to the developed Aurignacian of the Upper Palæolithic which is preserved as an 'ancient monument'. The deposits consist of two beds of cave earth, of which the lower and earlier extends from Early Mousterian to the proto-Solutrean which, with Aurignacian appears in the base of the upper bed.

As already mentioned, the lower deposit affords evidence of two glacial phases with a warm interglacial. If indeed these levels are correctly correlated with the Little Eastern glaciation and thus with Würm, this interglacial affords evidence of a North Midland retreat of the ice in relation to the Little Eastern which has not previously been recorded.

Upper Palæolithic Age

The highly significant evidence for the Upper Palæolithic period, drawn in part from cave deposits, in part from north Lincolnshire open sites, must here be dismissed in brief. Among the more interesting conclusions to which excavation has led, is the confirmation of the absence of any gap in continuity between Upper Palæolithic and Mesolithic, and at the close of the Aurignacian period the remarkable local variability in type of the elements of the culture. Two finds which must not be passed over are a fragment of mother-of-pearl skilfully shaped, possibly part of an amulet, and a cowrie shell, *Cypræa moneta*, from the Pin Hole Cave.

HEARING TESTS

IN the December number of the *Bell Laboratories Record*, Mr. H. C. Montgomery, of the Acoustical Research Department of the Bell Laboratories, discusses results obtained by subjecting many of the visitors at the World's Fairs to tests of the quality of their hearing. The records obtained enabled him to get nearly three-quarters of a million of records carried out in the same way.

The Bell system deals in hearing, and to get the best service it is important that it have available trustworthy data on the hearing characteristics of the American people. The tests are given in sound-proof rooms arranged to seat seven visitors, each partially screened from the others. Both the tests and the instructions are given through telephone receivers; the visitor holds the receiver to his ear with one hand whilst he marks the results on a card with the other. Two types of tests are given, with separate booths for each. In one the visitor hears spoken words, which are two numbers, such as "eight-six". The numbers heard are written on the card, and each successive pair is at a lower volume. Twelve pairs of numerals are spoken at successively lower volumes; and then the test is repeated with a different series. In the other type of test, the two numbers are replaced by pure musical tones, each tone being sounded from one to three times, and the listeners write down the number of times they hear the tone. Five tests, each consisting of nine sets of tones at successively lower volumes, are given. The first is a moderately low pitch, 440 cycles per second, which corresponds to *A* above middle *C* on the piano. Each following test is one octave higher in pitch and thus the hearing is tested at 440, 880, 1,760, 3,520 and 7,040 cycles.

At the San Francisco Exposition were three booths, one arranged for word tests, one for tone tests, and one that could be used for either. At New York eight booths were provided for each type of test. Only the tone tests were recorded. The word tests give only a check on one's ability to understand spoken words, while the tone test, by providing data at five frequencies over the most important part of the aural range, is more suitable for study and analysis. Before a record is made on the test card the attendant puts a mark on it to indicate whether the visitor is male or female, coloured or white, and to which of the five age groups the person belongs, the age groups extending in five groups between 10 and 60. The cards are then run through a Recordak machine which analyses the curves marked on them. The cards are then run through tabulating machines which analyse and sum up the data. The results of this survey indicate a definite falling in hearing acuity with age. This is in harmony with previous data, which indicate a definite falling off in hearing acuity with age, particularly noticeable at the higher frequencies. A rather remarkable fact is that at the low frequencies the falling off with age is less for men than for women, while at the higher frequencies it is less for women than for men. In the lowest age group the difference between men and women is small, but even here the advantage is slightly with the men at low frequencies and with the women at high frequencies. In the age group 50-59 years the difference becomes much more pronounced.

The curves show that for young ears and low frequencies, the tests are grouped fairly closely around the average. For older persons or higher frequencies, the distribution spreads and the number with average hearing becomes small; most differ from the average in both directions and in varying degrees. The interpretation of the losses at various frequencies needs a specialist, since the evaluation of the effect on one's ability to hear in any particular band of frequencies is a function of many factors. It has been found that one's ability to understand speech can be determined from the average of his hearing losses at 440, 880 and 1,760 cycles per second as compared with good young ears. If this average is 25 db. (decibels), there may be some difficulty in hearing in auditoriums and churches, while if it is 45 db. there may be difficulty in hearing in direct conversation. Only if the hearing loss is as much as 65 db. will there ordinarily be much difficulty in hearing over the telephone.

By use of these figures, the tests indicate that about one out of twenty-five persons have difficulty in hearing in auditoriums; one in 125 will have some difficulty in direct conversation; and one in 400 over the telephone. Two out of five men between 50 and 59 will have a loss of at least 25 db. at 3,520 cycles, while only one in five women will have as great a loss at this frequency. It was found also that about one in 25 of the group from 10 to 19 had a loss of at least 25 db. at 7,040 cycles. This figure is important, because it has been found that young people with a hearing loss of this amount will often be found to become progressively worse in later years, but if remedial measures are taken immediately, impairment may be largely checked. No significant difference was found between the visitors to the Fairs who were resident in New York and those resident in San Francisco. The time of day at which each test was taken was marked on the card and permits a comparison of the results for different periods of the day. No consistent difference was found between early morning and late afternoon. There is thus no indication of any effect being produced in the hearing by fatigue.

SEVENTY YEARS AGO

NATURE, vol. 1, January 13, 1870

Government Aid to Science

ALFRED RUSSEL WALLACE, in a letter to the Editor, writes: "The public mind seems now to be going mad on the subject of education; the Government is obliged to give way to the clamour, and men of science seem inclined to seize the opportunity to get, if possible, some share of the public money. . . .

"Now, sir, I protest most earnestly against the application of public money to any of the above specified purposes, as radically vicious in principle, and as being in the present state of society a positive wrong. . . . I uphold national education, but I object absolutely to all sectional or class education; . . . The broad principle I go upon is this,—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not directly available for the benefit of all. . . . If we follow this principle, national education is not forbidden, whether given in schools supported by the State, or in museums, or galleries, or gardens, fairly distributed over the whole kingdom, and so regulated as to be equally available for the instruction and amusement of all classes of the community. But here a line must be drawn. The schools, the museums, the galleries, the gardens, must all alike be *popular* (that is, adapted for and capable of being fully used and enjoyed by the people at large), and must be developed by means of public money to such an extent only as is needful for the highest attainable *popular* instruction and benefit. All beyond this should be left to private munificence, to societies, or to the classes benefited, to supply."

A New Thames Subway

THE importance of geological data on the extent of the London Clay was emphasized in an article by J. Prestwich, F.R.S., on the second Thames subway. "The first to apply this knowledge was Mr. P. H. Barlow, C.E., F.R.S., who fixed upon a spot intermediate between London Bridge and Limehouse (where the thickness of London Clay must be about 80 ft.), and at a sufficient distance below London Bridge to render an underground passage of the Thames a work of great public utility. . . . The tunnel is 7 feet in diameter, and is formed by cast-iron tubing in lengths of 1½ feet each, each ring being composed of thin segments with a key piece. An iron shield, devised by Mr. Barlow, was pushed on in advance of the work. . . . The passage under the river will be made in an omnibus, by means, probably, of a stationary engine; and lifts on either side will take the passengers up and down [the shafts]." The tunnel, 1320 feet long, was begun on April 26, and finished on October 8, 1869, without a single fatal or even serious accident to any of the men employed. It is no longer in use.

On the Periodicities of the Solar Spots

"Messrs. De la Rue, Stewart, and Loewy have for some time past been engaged in investigations [at Kew Observatory], which . . . go to show that there is an intimate and, as yet, unexplained connection between the configuration of the planets and the position and number of the spots on the sun. This result, which at once seems to land us in a sort of modern astrology . . . is . . . questioned by many European astronomers". Accordingly, a digest is given of independent investigations carried out by Dr. Kirkwood and published in the *Proceedings of the American Philosophical Society*. Among his conclusions were that the theory "has been placed beyond reasonable doubt", and the "11-year cycle of spot variation is mainly dependent on the influence of Mercury".

THE oxy-hydrogen light is now largely used in Paris for illuminated advertisements and theatrical purposes. Carts with metal reservoirs containing the compressed oxygen for the supply of customers may be seen in the streets. At the Gaieté Theatre, which is one of the largest consumers, cylinders of magnesia or zirconia take the place of the lime cylinders ordinarily used for this light.

PROF. HELMHOLTZ, of Heidelberg, has been elected a corresponding member of the Physical Section of the Paris Academy of Sciences.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

UNIVERSITY ASSISTANT IN BOTANY—The Secretary, The University, Aberdeen (January 20).

UNIVERSITY GRADUATE AS TEACHER OF ENGLISH for British-Peruvian Cultural Association, Lima—The British Council, 3 Hanover Street, W.1 (quoting 'Lima') (January 24).

LECTURER IN GEOGRAPHY in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (February 5).

LECTURER IN MECHANICAL ENGINEERING in the Witwatersrand Technical College, Johannesburg—Frank Ross and Co., 9 Fenchurch Avenue, E.C.3

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society Vol 22 (N S.), No 18 On a Recent Bog Flow in Powerscourt Mountain Townland, Co Wicklow By A. D Delap and G F Mitchell. Pp 195–198. (Dublin Hodges Figgis and Co Ltd, London Williams and Norgate Ltd) 6d [2712

Board of Trade Statistical Abstract for the British Empire for each of the Ten Years 1929 to 1938 (Trade and Commerce Section). Sixty-eighth Number (Cmd 6140) Pp. xv+234 (London H.M. Stationery Office.) 3s 6d net [2712

Royal Meteorological Society Bibliography of Meteorological Literature. Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office Vol. 4, No. 7 (January–June 1939) Pp 351–414 (London Royal Meteorological Society.) 2s 6d [2712

Other Countries

Ministry of Agriculture Egypt Technical and Scientific Service Bulletin No. 231 The Incidence of Contagious Abortion in Domestic Animals in Egypt By Dr Mohamed Ragheb Ahmed. Pp 29. P.T. 4. Bulletin No 226 Further Studies on the Control of Bean Rust, with some Reference to the Prevention of Chocolate Spot of Beans. By A. F. El-Helaly Pp 24 P T 4. (Cairo: Government Press.) [2712

Meddelanden från Oceanografiska Institutet i Göteborg. 2 The Radioactivity of Seawater By Ernst Föyn, Berta Karlik, Hans Pettersson and Elisabeth Rona Pp. 44. 3 Large-scale Plankton Cultures. By Hans Pettersson, Fabius Gross and Friedrich Koczy. Pp. 25. (Göteborg Elanders Boktryckeri A.-B.) [2712

Carnegie Corporation of New York Report of the President and of the Treasurer for the Year ended September 30, 1939. Pp. 165. (New York Carnegie Corporation of New York) [2812

Catalogues, etc.

Pocket Diary for 1940 (Bouxbridge John G. Stein and Co., Ltd.)

Desk Engagement Pad for 1940 (London W. Edwards and Co.)

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DIRECTION AND UTILIZATION OF RESEARCH

IT is not always realized that, when research in the laboratory has succeeded in producing a new article or product for manufacture, it is probable that a considerable amount of capital has to be spent—not only on plant, but also on overcoming engineering and chemical difficulties, and often in creating a demand for the product —before any return can be obtained. Under modern conditions one individual can rarely take all the steps required for the development of a new product—the research work, the design and running of the small-scale plant, the market investigations, the design of the full-scale plant, the building of the factory, the running of it, the management of labour, the control of output to meet the demand, the creation of demand, the actual selling and the finding of the capital to erect the plant and for trading. Most of these steps require specialists, and it could scarcely be expected that one man should have the knowledge to do them all well; if he had, it would be difficult for him to decide to which he should give his chief attention as the development proceeded.

Let us consider where and how research comes into the scheme of things. In the beginning, it is not usually obvious that a research reaching a successful conclusion is one suitable for development. Although a successful development may afterwards seem to have been very obvious, it was probably not so obvious at the time. There are always doubts as to the potentialities of the market, and even perhaps as to the availability of the raw materials at a cost which will leave a profit. A decision has to be made; a risk has to be taken. Hence the question of finance enters into the problem, for those responsible for finding the capital have to be persuaded that the risk is a reasonable one. This task is an important function of the 'director of research', and without him there are sure to be difficulties, misunderstandings, and perhaps in some cases recriminations. It is a matter of experience that the research worker who makes the discovery or devises the process is rarely the best person to win the necessary confidence of an administrative board.

It is of first-rate importance, therefore, to consider the qualifications of a successful director of research. First of all, he must be himself a scientific worker. He must understand the research workers' outlook; he must encourage their enthusiasms. On the other hand, he must have a keen appreciation of developments on which the administrative body is prepared to spend money He must know as much as he can of all branches of the industry from manufacture to sales, or he will never be able to understand the outlook of the administrative board. His knowledge of science should enable him to have a broad idea of the lines on which the industry may be expected to develop, and he should continually keep the board and departmental managers informed of the lines on which he expects development to be made.

Although the director of research will not find much time for doing research himself, he must not allow administration to become his chief interest. He must believe in the scientific method of approach to a subject; he must be continually assisting in summarizing and relating the results of incompleted researches, and to do this he must have been a successful research worker himself. He should be a helpful critic of the researches of his staff.

While it may be conceded that an able director of research is needed in a commercial company to obtain the confidence of the administrative body for the development of scientific discoveries, it is not generally appreciated that directors of research of Government departments and research associations have similar tasks There are now a considerable number of directors of research in Great Britain, and they have been an essential factor in the successes which science has achieved in industry and in the arts of peace and war. But the functions of these men are not generally understood by men of science, by Government departments, or by politicians, though these services are realized by many industrialists. Their services to science itself are rarely recognized, although some of them have been elected to the fellowship of the Royal Society before they became directors of research. It is generally impossible for the successful director of research to devote himself sufficiently to one subject, and in consequence this acknowledgment from the world of science rarely comes his way.

At the present time, when ministries and Government departments are being subjected to frequent scrutiny, it is opportune to recommend to them the inclusion of a director of research in their organizations. Some of the ministries have them, and probably would not be without them now. Others have scientific advisers who give advice when asked, but this is not what is required. Every ministry should have, as an integral part of its personnel, a director of research, in close touch with *all* its problems, whose principal duty would be to advise the ministry when the man of science can be helpful. The director of research would not, as a rule, attempt to give the scientific advice himself, but a small organization under his control would see that it was obtained from the best sources available, and, as further research would be needed in most cases, he would arrange for it to be done. The Ministry of Food should certainly have a director of research, and the Ministry of Agriculture too; he would enable these ministries to make fuller use of the Agricultural Research Council, and the Medical Research Council, as well as other research workers. Another department which might well have a director of research is the Board of Trade, to enable the Board to make use of the potentialities of the Department of Scientific and Industrial Research. Appointments such as these would add relatively little to the budgets of the departments concerned, but would go a long way towards ensuring efficiency in the utilization of the scientific resources of Great Britain.

DESIGN IN NATIONAL LIFE

The Shape of Things

An Introduction to Design in Everyday Life. By Noel Carrington. Pp. xv+209. (London: Ivor Nicholson and Watson, Ltd., 1939.) 6s. net.

A SUGGESTIVE chapter in Bavink's "Anatomy of Modern Science" is devoted to a discussion of the technological ideal of fitness for a purpose. Over an increasingly wide sphere of life we are becoming aware to-day that the squalor, ugliness and lack of beauty in our surroundings are due at least in part to the neglect of this principle. The deplorable position of the Special Areas can be directly attributed, as the successive reports of the commissioners for those areas show, to our lack of design in the planning of industry. The acuteness of the problems in the government of London can be traced to a like cause, and chaos in transport, ribbon building and the destruction of amenities have a similar origin in the absence of any comprehensive design sufficient to compel planning and control on an adequate scale.

It is not only in such matters that we have failed to utilize the possibilities which new materials and new means, put at our disposal by science, have afforded. In the smallest things of everyday life, the use of such materials or forces is apt to be determined less by their intrinsic qualities than by the traditional forms in which the materials they are superseding or displacing have found expression. Outstanding examples are to be found in the tardiness with which the motor-car has freed itself from forms imposed by the tradition of the horse-drawn vehicle, and the resistance of the building industry to the adoption of new forms and possibilities inherent in the steel framework or the new plastics.

Resistance or delay of this type is, however, not due entirely to the conservatism of the manufacturer. It is also partly due to the absence of a public awake to the possibilities and sufficiently

alive to the fundamental principles of design to demand appropriate forms of expression for the new means and materials.

Mr. Carrington's little book has the great merit of giving in a very brief compass a comprehensive picture of the incidence of design in everyday life, from the ordinary utensils of house or office, houses, streets and vehicles to the larger problems of planning a city or a countryside Much more is indeed being done than Mr. Carrington suggests to interest the general public in design, and he does not mention the distributor, the advances recently made in the education of salesmen, or the efforts of the Royal Society of Arts to raise the status of the artist in industry Apart from such omissions, Mr. Carrington covers the field well, and the brief notes on books appended to most of the chapters contain numerous excellent suggestions for the guidance of those who wish to proceed further with any particular subject

The appearance of the book is opportune even in war-time for two further reasons In the first place, as Mr Milner Gray has pointed out, industrial design is of the utmost national importance in the development of our export trade If we are to maintain our position in the markets of the world which remain open to us, or to capture those to which Germany no longer has free access, the design of our export goods must be second to none It will not be sufficient to produce the most obvious export goods under the rigorous conditions now existing We must demonstrate that on top of meeting all our war-time needs, we also have capacity for quality production

The importance of this to our economic position is obvious If we cannot get loans, we can in this way obtain orders for goods, the making of which is as truly war work as any other For this purpose the mere repetition of old patterns and shapes will not suffice We have to show that our goods are not only better but also more attractive, and we shall have to make full use of all new good designs if the opportunity is not to be missed

The second reason why Mr. Carrington's book is timely lies in the opportunities for improved design which should be ours in the reorganization and reconstruction which must be involved during and after the war. The profound disturbance of the fabric of our social, educational and business life under the demands of civil defence, no less than the adjustment of industry in general to meet the problems of supply or the reorientation of administration, whether in local or national affairs, present opportunities as well as problems. The present chaos in our physical surroundings persists less because we lack the knowledge of a remedy than because we lack the collective will to set things right. Not enough people have trained themselves to appreciate the nature of the problem Scientific research and technique have far outstripped our ability to put them to proper use

While the same principles inspire design wherever it operates, a wider cultural education is desirable if a sense of design is not to be departmentalism. This is indeed the gravest danger and the biggest obstacle to rational design in the larger matters of traffic problems or town planning and the like A highly developed aptitude for design in a particular field may be accompanied by complete indifference to it either in the intimacy of the home or in civic or rural surroundings. The design so essential in our major collective enterprises can only be secured as individuals appreciating the value of design in some particular field are led to appreciate its importance everywhere

Recognition of the place and value of design is indeed essential if the resources of modern science are to be utilized to rebuild our physical surroundings to serve adequately both our needs and our desires One of the real tragedies of this age is that the divorce of the artist from the business of life has led to the great reconstruction which the machine age has necessitated being carried through without his aid. Only here and there are the new materials finding expression in new and more appropriate ways which satisfy not merely utility but also the æsthetic and creative sense.

There are indeed increasing signs that we are coming to recognize that the artist as designer is as essential a factor in our mechanized activities as he was in ancient Greece or any other period of history. If, however, in a few fields the opportunities which new materials offer for creative expression are being explored, the opportunities which are to be found in the planning of our cities, the development of transport, the preservation and development of the countryside are largely ignored. To awaken the mind of the ordinary citizen to these possibilities, to assist him to form an intelligent opinion upon them and to lend his support unhesitatingly and persistently to those seeking to use them is an urgent need, if those opportunities are not to be missed. In this task of education, leaders of art and industry with vision and creative force are imperative. Mr. Carrington's little book is well calculated to stimulate thought upon these larger issues, to facilitate the understanding which will assist the reintegration of the artist into society, and to inspire a concern for creative work which should enable us to build a nobler culture and a saner social order out of the chaos and destruction in which we are at present involved.

R. Brightman.

EARLY MAN IN UPPER EGYPT

Rock-Drawings of Southern Upper Egypt
1 : Sir Robert Mond Desert Expedition, Season 1936–1937, Preliminary Report By Hans A. Winkler Pp viii + 44 + 41 plates (London Egypt Exploration Society, and Oxford University Press, 1938.) 18s net

THE interest of the late Sir Robert Mond in the rock-drawings of the Egyptian desert was aroused by a collection of copies which had been made by Dr. Winkler in 1936, and with characteristic generosity and an equally characteristic ready appreciation of the possibilities of this line of research for the early history of man in Egypt, he undertook the responsibility for an expedition for the systematic study of the rock-drawings of Upper Egypt In this preliminary report, Dr. Winkler summarizes and illustrates the results of his first season's work in 1936–37, dealing only with the most interesting and instructive examples, comprising about one tenth of his photographs The material collected by the expedition has been deposited at the office of the Egypt Exploration Society, where it is available for consultation by students.

Of the possible methods of investigation, the author selected on this occasion the intensive study of a circumscribed area, choosing the country between Qena and Asswân Most of the work has been carried out in the Eastern Desert between Quft and Qosêr, while in the Western Desert two small districts were worked near Armant, when Dr. Winkler enjoyed the advantage of being helped by members of an expedition of the Egyptian Exploration Society then excavating there.

The conditions in the two regions are markedly different. On the eastern bank of the Nile, profitable investigation was in the main confined to the sandstone formations of the Quft wadi-system, by which go the shortest routes to the Red Sea and the Sinaitic Peninsula. An old road with wells crosses the desert. On the west there are no such natural limitations. A seemingly endless limestone plateau borders the Nile, which is crossed by many roads. It is especially along such roads that rock-drawings are found; and, indeed, the presence of rock-drawings has sometimes indicated the existence of a road which had vanished. The author, however, draws a distinction. He points out that frequenters of the desert fall into two categories: those who are permanent inhabitants, such as the Beduin, and those who visit it as travellers. This distinction applies no less to early than to modern times, with the result that while drawings by travellers from the Nile valley as well as drawings by desert tribesmen are found along the lines of the roads, the drawings of the desert peoples may also be found anywhere in the desert

Forty sites were visited The subjects of the drawings are of a greatly varied character, ranging from purely geometrical signs to relatively realistic figures of men and animals Boats of more than one type are plentifully represented—in fact, more plentifully than in any other group of rock-drawings, with the possible exception of Scandinavia. One rock painting only was discovered This was in the Eastern Desert. It represents a man (dark red), archer (light red), ibex, and another animal (brown) It shows no artistic sense and its date is uncertain.

A proportion of the petroglyphs can be classified on adequate grounds as modern or ancient Arab, while others belong to either the Græco-Roman-Coptic period or the Dynastic. The majority of those of the Græco-Roman-Coptic period are assigned to the people known in antiquity as the Blemyans, a desert people, who rose to ascendency in the period from the third to the sixth century of our era. With them the camel appears for the first time in desert drawings; and its use was, no doubt, at the root of their political and economic domination.

The greater number of the drawings, however, cannot be dated with this certainty; and the conclusion as to their age rests upon the character of the drawings themselves and attendant conditions—position, superposition, patination, archæological finds, and the like They are classified as Early, Pre-dynastic, and Prehistoric. Dr. Winkler assigns them to four distinct ethnic groups, for whom he has worked out a relative chronology.

These groups are as follows: (1) Autochthonous Mountain People, Hamites and cattle-breeders, who lived not only in the Eastern Desert, but also penetrated deeply into the Western Desert. The men wore the Libyan sheath. They may be regarded as the ancestors of the Blemyans. They appear to have outlived the elephant and giraffe, and probably introduced cattle into this region. (2) Early Nile Valley Dwellers, with boats showing affinities with those appearing on pre-dynastic pottery. This people was an intrusion from the Nile, and lasted down to dynastic times. (3) Eastern Invaders, a people previously almost

unknown. They appear with boats of a foreign type, first recognized as such in Dr. Winkler's expedition of 1936. The boat, though a proof of early Mesopotamian influence, is probably of other, but unidentified, origin. This people is contemporary with elephant and giraffe, and was in contact with both Mountain Dwellers and the Nile Valley people. They did not penetrate the Western Desert. (4) Earliest Hunters, whose discovery must be placed to the credit of this expedition. They hunted elephant and giraffe, and are represented in both the Eastern and the Western Desert.

Though no specimens of the common type of Libyan sheath-wearing peoples have been found adjacent to the river on the western bank of the Nile, parallels to the older wedge-style of the Libyan sheath wearer, but with not unimportant differences, are known from the distant 'Uweinât' and elsewhere in the Libyan desert. At the same time, it is to be noted that the author claims a possible Hamitic origin for a group of drawings on the west side of and near the Nile, otherwise remarkable as the only example in the whole collection which can be called a work of art. An appendix deals with the characters of the boats and their relation to other representations of boats in early Egypt and Mesopotamia.

Dr Winkler displays great acumen and powers of observation in his interpretation of these drawings as indications of the respective material culture, social organization and religious beliefs of his four ethnic groups. He is to be congratulated on the successful result of his investigations; and the continuation of a study which promises to throw so much light on the movements and cultures of the early peoples of these regions will be awaited eagerly

MECHANICAL ANALYSIS OF SEDIMENTS

Manual of Sedimentary Petrography
1. Sampling, Preparation for Analysis, Mechanical Analysis, and Statistical Analysis, by W. C Krumbein; 2. Shape Analysis, Mineralogical Analysis, Chemical Analysis, and Mass Properties, by F. J. Pettijohn (Century Earth Science Series.) Pp xiv+549. (New York and London: D Appleton-Century Co, Inc., 1938.) 30*s*. net.

THIS interesting book is divided into two portions: the first by Krumbein deals with size determination of sedimentary particles, and the second part, by Pettijohn, is largely concerned with the optical properties of minerals. All who are interested in sediments will find this book most useful, as it contains descriptions of various techniques and methods of interpretation.

Krumbein, after discussing the collection of samples, suggests methods for the preparation of stable suspensions. One chapter is devoted to grade scales, and the advantages of a geometrical scale are pointed out. A theoretical discussion on the principles of size analysis follows, and those who are unacquainted with this subject will find a clear and adequate explanation. Although there is a wide choice of methods available for mechanical analysis, the present tendency is to use mechanically operated sieves for particles greater than 50μ, and the pipette method for smaller particles. For accurate work elutriation methods find to-day little favour in sedimentary laboratories. The pipette method is described in detail, but the accuracy of this method is not discussed. It would seem, however, important that the investigator should not only realize the experimental errors, but should also carry out occasional duplicate analyses, preferably adopting a slightly different technique Only one page is devoted to the application of centrifugal force to mechanical analysis, a method which is most useful in fine-grained sediments

The remainder of Part 1 is largely concerned with graphic presentation of results. Histograms, cumulative curves, frequency curves are described, as well as the elements of statistical analysis. The reader will find a clear and non-mathematical introduction to quartile measures, moment measures, measures of central tendency, of dispersion, skewness and kurtosis. Finally, some special statistical methods are briefly described and a discussion is given concerning the choice of statistical devices.

To the mineralogist Part 2 of this book is not very important, as optical methods of identification have been frequently described, but to the non-mineralogical student the inclusion of this portion will be useful. The procedure for analysis of shape and roundness is also discussed, as well as methods for mineralogical separations; but chemical methods of investigation are limited to five pages.

The book as a whole can be thoroughly recommended, and the authors are to be congratulated on collecting together from many sources a large amount of information, and thereby making it more readily accessible. J. D. H. W.

FOUNDATIONS AND DEVELOPMENT OF HEAT

A Text-Book of Heat

By Prof. H. S. Allen and R S Maxwell. Part 1. Pp ix + 527 + xvi. 10s Part 2 Pp. x + 531 – 849 + xi. 10s. 6d. (London: Macmillan and Co., Ltd., 1939)

RECENT years have seen the production of several books on heat such as Roberts's "Heat and Thermodynamics" and Saha and Srivastava's "Treatise on Heat", to say nothing of more special works such as Hoare's "Thermodynamics" But the work now before us occupies a place of its own and will be welcomed by teachers who wish for something between an elementary text-book and a comprehensive treatise It gives the best of the earlier work and at the same time includes some account of recent investigations.

The authors emphasize the fact that they treat the subject from the historical point of view, and there are full accounts of fundamental experiments by Joule and others, quotations from authorities, and many biographical notes But while this undoubtedly makes the subject more interesting, there is little difference between the order of historical development and that of logical development, and the historical treatment does not impress the reader so much as the easy and gradual way the student is led into the subject

There are two contrasting ways of writing a text-book of physics. One way is to give clear, concise statements suitable for reproduction in an examination and not going much beyond the range of the examination, the other is to proceed by degrees, to build up a mental picture of every equation and to make the accounts of the experiments as full as possible. This is pre-eminently the method of the authors of this book and the reason for its 849 + xlvi pages They read very easily because every chapter is obviously the result of teaching experience. After reading and understanding a book such as this, the average student is able to make his own synopsis of the subject, whereas if the concise statement were thrust at him at first, he might make nothing of it. It is, of course, for the student of physics the book is written; the mathematical honours man may wish to travel faster.

Part 1 is intended for students preparing for the Higher School Certificate or Intermediate Examination in physics or for a university scholarship. The calculus is used occasionally, but the mathematical treatment is very simple. Part 2 is intended to meet the requirements of those reading for a pass degree in physics and to furnish a foundation for an honours course

Near the beginning of Part 1 we notice the customary account of Davy's experiment on rubbing the plates of ice together. Prof. E. N. da C. Andrade (NATURE, 135, 359; 1935) has some hard things to say about this experiment. It was carried out when Davy was a country lad of nineteen years of age. If the ice is covered with a film of water, the friction is so small that scarcely any work is done at all, whereas if it is really dry it is liable to stick To make the frictional heat appreciable it is necessary to have a normal force holding the two surfaces together, and then there is the well-known lowering of the freezing point and consequent melting. Again, the amount of heat required to melt 1 gm. of ice is very large; the criterion is a very insensitive one, and no one has ever tried to repeat the experiment. The effect was due to conduction, and the experiment should cease to rank with such a convincing demonstration as that of Rumford. The customary account of the experiment must be allowed to stand in the old text-books; but in view of these statements something different is called for in a new one

In a book written as a text-book for definite examinations, it is not possible to be very original, and Part 1 develops on conventional lines. Everything that could possibly be asked for in the examination is given; this is saying a lot, because examiners in physics do not keep to well-defined curricula, which makes it anything but a safe subject in Civil Service and other examinations. There are also questions from the examination papers of different British universities, with the answers.

But while this first volume is, generally speaking, on conventional lines, some things such as the steam and internal combustion engines, the liquefaction of gases, etc., are done unusually well, and the last three chapters, which deal with meteorology and the dimensions of thermal quantities, are an interesting innovation. We note in passing that the theory of the experiment of Clément and Desormes is given and that it is followed by the statement that the experiment does not work; but we are not told definitely that Gay-Lussac and Welter's modification of the experiment is any better.

Part 2 gives more scope for originality of treatment. The first half of the book is thermodynamics, but thermodynamics treated from the experi-

mental point of view, which makes it easier to assimilate. The experimental physicist will, of course, object to the chapter on thermodynamic functions and relations, but this is inevitable. Then after an account of the approach to the absolute zero, which includes the paramagnetic method and a full account of Nernst's heat theorem, there are accounts of the mathematical theory of conduction, convection, the measurement of radiation, the quantum theory and the modern theory of the specific heat of solids. The last thirty-five pages deal with statistical mechanics, the Bose-Einstein statistics and the Fermi-Dirac statistics each receiving a couple of pages. Larmor's indirect pressure theorem is a welcome innovation. The simplest definition of entropy is omitted, namely, that the increase of entropy of a substance multiplied by any low temperature gives the increase of unavailable energy of the substance with reference to that temperature, and there is no description of the photo-electric rectifier cell in the chapter on the measurement of radiation It is difficult nowadays to say where heat stops and electricity begins, but we think this instrument ought to have been included. These are minor points.

The space given to statistical mechanics and probability is undoubtedly a move in the right direction. These concepts are becoming very important for the purpose of understanding the world around us. But it is not easy to write an account of them for the average student.

Altogether the work is a notable addition to the text-books on heat. It is the work of practised teachers and is written with great care. It is alive with modern information and research; besides being a text-book it is a storehouse of information, reference to which is greatly facilitated by the excellent indexes at the end of each volume. Much of this information the student will find unnecessary, but it will serve as a background to his knowledge and perhaps as a basis for research. The type and paper are excellent R. A. HOUSTOUN.

SYSTEMATICS OF MILLIPEDES

Myriapoda 3, Polydesmoidea II, Fam. Leptodesmidæ, Platyrhachidæ, Oxydesmidæ, Gomphodesmidæ

Bearbeitet von Dr Graf Attems (Das Tierreich: eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin Herausgegeben von F. E. Schulze, W Kükenthal, K Heider, fortgesetzt von R. Hesse. Lieferung 69.) Pp. xxviii + 487. (Berlin und Leipzig · Walter de Gruyter und Co., 1938.) 81·25 gold marks.

ANY work on the Polydesmoidea from the pen of Count von Attems must command repsect. His contributions to our knowledge of a taxonomically difficult group have been very numerous and he is of course well fitted for the task of drawing together the threads of description and weaving them into a serviceable whole. The volume under notice begins with a list of works of reference occupying ten pages, and similar space is devoted to a clear and very useful systematic index. The author then plunges into the real business in hand to give nomenclatural particulars and full descriptions of the families mentioned in the title and to deal with all their subdivisions down to subspecies and varieties. It is a formidable task, for more than eight hundred species, certain and uncertain, need consideration.

In the nomenclatural jungles where Chondrodesmus, Allarithmus and Phlyzakium roam there are pitfalls for the wary as well as for those less careful. Even specialists find the name of Platyrhacus (a genus with more than 180 described species) difficult to spell. Since C. L. Koch first used the name in 1847, it has also been Platyrhachus, Platyrhachis, Platyrrhachus, Platyrrhacus, Platyrrachus, Platyrachus and Platyracus, but we seem to have got it right at last. Not so the family appellation, for here even Attems himself goes astray with Platyrhachidæ, a name that appears both on the cover and title page of his work.

In his description of colours, Attems meets a difficulty most naturalists encounter. Until some general colour standard is adopted it seems best to decide upon the fundamental colour 'brown', 'yellow', 'black' or whatever it may be and then to add adverbial modification where this is necessary

In spite of the thorough treatment adopted by Dr. Attems, there is a sense of disappointment with the way in which this expensive work is illustrated Figures that are of great value for taxonomic purposes are liberally included, they are admirably clear in spite of the variety of their sources, and the lettering is excellent, but there is no adequate reminder that we are really dealing with living animals and that it is, after all, a branch of natural history that is under consideration. We go back in mind nearly eighty years to H. de Saussure's paper on the myriapods of Mexico. To look at those wonderful plates was to realize that millipedes are really alive, and it gives the naturalist a sense of satisfaction for

which the scientific accuracy of the present day is no real substitute. We want both kinds of illustration; at least a few figures of the old kind to cheer the pages and make them less dull, and to take away the impression that we are dealing with nothing but dried specimens in a museum collection and that the subject is a drab one. *Eutheatus erythropygos* (Brandt, 1841) is a good example because it is on de Saussure's first plate Attems gives us a neat little figure (after Carl) of the gonopod, and very useful it is, but how much more satisfactory it would have been if we could have had de Saussure's delightful drawing of the whole animal reproduced as well. When no figure of the gonopods is available, it is still more to be deplored that no such illustration as that given by de Saussure is included by Attems. An instance of this is provided by *Rhysodesmus zapotecus* (Sauss.); de Saussure admirably depicts the whole animal.

Sometimes the treatment adopted by Attems is difficult to understand Take *Platyrhacus* (*Tirodesmus*) *mexicanus* (Lucas); although Attems gives no description, this species is fully described and segments figured by de Saussure. Of the species *P*(*T*) *bilineatus* (Lucas) which de Saussure regards as near *P*(*T*) *mexicanus*, Attems gives a full description with one figure (side-view of gonopod).

When all is said, however, and we come to the end of a series of minor criticisms, we feel that Count Attems has done systematists a great service. More power to his pen!

S. GRAHAM BRADE-BIRKS.

GEOLOGY OF INDIA

Geology of India
By D N Wadia Second edition. Pp xx+460+20 plates (London: Macmillan and Co., Ltd, 1939.) 24*s* net

THIS book, which from its first appearance has been the standard text-book of Indian students, has now been brought up to date by the addition of recent advances in Indian geology. The new geological map is an added attraction

The revision has not, however, been sufficiently far-reaching and thorough As a result, a novice to the subject of Indian geology will occasionally be puzzled by finding both the old and the modern view stated without due explanation.

The Salt-Range is regarded (p. 104 and Fig. 8) as a block-faulted structure, but later in the book we are told that over-thrust faulting is a marked structural feature

On pp. 146 and 147, it is noted that the Upper Gondwanas of the Madras coast and probably the Rajmahal beds also must now be regarded as Lower Cretaceous and not as Jurassic. These recent conclusions—the work of Dr Spath and Prof. Sahni—should have caused a more extensive revision of the whole subject, including alterations in the tables on pp 51 and 130

In the table of the Siwalik stages on p. 271, the views of Dr Pilgrim as to age are given. But in a later table on p. 280 we find an entirely different view of the ages put forward by Dr. de Terra. An explanatory note was here called for.

Before writing his account of the Bagh Beds and the "Cenomanian Transgression" (p. 206), Mr. Wadia would have done well to have studied the views of Dr. Spath on the subject (*Pal. Ind.*, New Ser **15**, Part 5, 64).

The account of the Samana section and the Hangu Shale fauna is too brief in view of its importance (see p. 246).

Perhaps the most disappointing chapters are those dealing with the Indian pre-Cambrian. There is no basis for the separation of the Himalayan pre-Cambrian into Archæan and Algonkian, as is attempted on pp. 81 and 99, and, as the age of the supposed Burmese pre-Cambrian is even more doubtful, it was not correct to place the Mergui series in the Archæan (p. 54).

Considering the great advance made in the study of the Peninsular pre-Cambrian by the Indian and Mysore Geological Surveys of recent years, the account is meagre and not free from intermixture of old and new views (for example, age of Bundelkhand gneiss on pp. 62, 63 and 73). The modern correlation of these rocks should have been given, and the views of M. S. Krishnan (Twenty-second Indian Science Congress, 1935), which admirably express the general opinions of the staff of the Indian Geological Survey, might have been studied.

In short, the entire rewriting of these chapters, and of that dealing with the Upper Gondwanas, would have improved the book. Nevertheless there is much valuable new material, especially regarding the Salt-Range, North-West India, and Kashmir. The structure of the Himalaya—the results of the work of West, Auden and Wadia himself—is excellently summarized in Chapter xxv. Those portions dealing with marine fossiliferous rocks and with economics are also of a high standard, and, in spite of such defects as those noted above, Mr. Wadia is to be congratulated on his new edition. G. DE P. COTTER.

ERNST ABBE (1840-1905)

THE ORIGIN OF A GREAT OPTICAL INDUSTRY

THE great optical works of Zeiss in Jena, employing round about ten thousand people, is one of the leading firms of the world in the production of fine optical apparatus This firm owes its high scientific standard, its economic efficiency and its growth to the creative genius of Ernst Abbe. The optical works of Carl Zeiss were originally the workshop of a skilful mechanic producing the necessary equipment for the laboratories of a small provincial university The scholar Abbe gave to the mechanic Zeiss the results of his original scientific research This was then leading to new methods in the design of optical apparatus, especially of microscopes Those new instruments were of extraordinary perfection, so that an enormous demand from every part of the world made possible an extremely rapid expansion of the business When after twenty years of growth, the well-known company had developed, Abbe renounced all his rights and gave the firm of Zeiss a constitution which has enabled it to survive its creator and to continue into our own turbulent times

Ernst Abbe was born on January 23, 1840, as the eldest child of a poor workman. It was beyond the means of his father to provide a higher education for him. The boy started in an elementary school. Later, the generosity of the employers of the father secured a scholarship at a higher school for the boy, who early showed signs of an unusual intelligence.

In 1857, Abbe began his studies in Jena, which was at that time still a small town with a population of less than seven thousand. Jena was living then in idyllic isolation from the great world ; no railway touched it. The university was incredibly small. Its faculty of science consisted of three professors only, who were paid an average salary of £30 a year. Abbe studied in poverty ; his father could provide very little for him. He augmented his income by giving private lessons. It is not surprising that he had to live in the cheapest quarters, and it was no unusual event for him to replace a hearty meal by a pipe of tobacco. But in spite of all hardships, the two years in Jena meant a happy time for Abbe, who there acquired a knowledge of the fundamentals of the mathematical and physical sciences.

In 1859 Abbe continued his studies in Göttingen. He left Göttingen in 1861 with a Ph.D. The next two years were spent as lecturer to a private physical association in Frankfort Although this engagement for popularizing science was not to the taste of a personality like Abbe, it brought him social contacts which proved to be important. When, in 1863, he was admitted as an unpaid lecturer at the University of Jena, a rich merchant of Frankfort enabled him to start his academic career by a personal grant sufficient to cover all his initial expenses During his early years Abbe was kept busy with running practical classes and with preparing and delivering lectures This was the beginning of his activity as a university teacher, which was destined to last for thirty-five years until 1898 He became associate professor in 1870 and full professor in 1878. He refused the most tempting offers of appointments in other universities, and spent the whole of his time in Jena During the course of time he gradually dropped his mathematical lectures, specializing more and more in physics and eventually in optics only. His last lectures were of the widest interest, and were attended by the staff of his industrial co-operators and by distinguished scholars from all over Germany. From his early years he was closely attached to the professor of physics, K. Snell, whose daughter Elise he married in 1871.

While still a young lecturer, in 1866, Abbe came in close contact with Carl Zeiss. The little workshop of Zeiss was then successfully producing simple microscopes which could well compete with other instruments of this kind. All these microscopes were made according to a practical tradition developed by empirical methods. Abbe was the first to introduce scientific methods and systematic design. He recognized that the magnification of an even ideally corrected microscope was limited There were no prospects whatsoever of resolving optically two parts of an object separated by less than about half the wavelength of the illuminating light, that is, about 0·0003 mm. This is of the greatest importance, because it indicates clearly that the only possible way of developing the microscope was by elimination of the optical errors within the limitation of reasonable magnification. Two lines of attack were available : first, the geometrical shape and the arrangement of the refracting lenses ; secondly, their physical properties, that is, their refraction and dispersion. Abbe made fundamental progress in both directions. His new results were at once applied in the optical workshops of Zeiss.

The new microscopes were far better than anything on the market, and thus the business of Zeiss's workshop expanded rapidly Soon after (in 1876), the sale of the three thousandth microscope was celebrated, and in the same year a contract was concluded making Abbe an equal partner in the business The glass sorts which were commercially available and which Zeiss used as a raw material were very much alike Abbe tried to interest leading glass manufacturers in the production of new glass sorts with different optical characteristics The small quantities of glass consumed in the microscope industries, however, did not guarantee a reward for these expensive experiments In an interesting lecture during the London international exhibition in 1876, Abbe tried to interest scientific societies in his problem, but he was unsuccessful.

Abbe's appeal, however, was taken up by a young glass manufacturer, O Schott, who was able to see beyond the immediate small practical prospects towards the great scientific and technical importance of the problem. Schott's father owned a small factory producing plate-glass in eastern Germany. Abbe persuaded Schott to move to Jena and to start a glass technical laboratory with him New glass sorts—especially borate and phosphate glasses—were developed there, opening up new prospects for the optical industry. From this laboratory arose the famous Jena glass-works. In 1884 these glass works were started with twelve employees , the Ministry of Finance of the State of Prussia secured a subvention for the first two years In the years which followed, the Zeiss works took up the manufacture of all kinds of optical gear, including, besides microscopes and telescopes, fine photographic objectives, prism-telescopes, telecomparators and periscopes, which are all produced in relatively large quantities. Of more specialist interest is a large number of types of other apparatus which were originally designed by Abbe, for example, spectrometers, refractometers, spherometers, apertometers and many more.

In the meantime, the firm of Zeiss expanded year by year. In 1899, a thousand workers were employed. At the time of Abbe's death in 1905, the number of 1,500 employees was passed Before the War of 1914–18, six thousand employees were engaged in the works. Owing to the heavy demands for optical gear for war purposes, this number increased temporarily to nearly ten thousand, but it dropped to a half this number immediately after the War Since then, the number of employees has gradually increased again, and to-day it has probably passed the former peak-level.

Of Abbe's scientific papers his discussion on image production in microscopes is still of great interest. At the age of twenty-eight, he formulated his famous sine law. A few years later, in a fundamental theory, he demonstrated the connexion of the projection of optical images with the diffraction of light waves. According to his theory, the aperture of the microscopic objective has to be large enough to collect an essential part of the diffraction pattern

It is remarkable how quickly Abbe's discoveries became known in England. He was in the closest contact with English men of science—Crisp, Mayall, Wenham, Lettsom and Stephenson A correspondence of more than a thousand letters with these English friends is preserved. All of them showed the greatest affection and admiration for Abbe. Stephenson wrote of him :

> "Objectives and their laws lay hid in night,
> God said : 'Let Abbe be, and all was light.' "

Abbe had worked for fifteen years managing and directing the great optical firm when, in 1891, he gave it its well-known constitution. He renounced all his property rights, making himself an employee of the great organization. The fact that one of the statutes of the constitution limits the maximum salaries in this firm to ten times the amount of the minimum wage paid, shows that the remuneration of the directors cannot be excessive. The Zeiss Institution is registered as the legal owner of the company, no shares being issued. Care and custody of the Institution is entrusted to the Ministry of Education of the country. The undertaking, however, is not subject to the control of the Government administrator, but solely to the provisions of the charter, and the function of the official administrator is to see that these provisions are carried out. The works are controlled by a board of three or four directors who have to be elected by the Minister of Education from the scientific staff and from the technical and administrative employees of the company. All the earned income is received and distributed by the Zeiss Institution. In these circumstances, the employees enjoy extraordinary benefits and their health and social welfare are first considerations.

Abbe was a true Christian, though he was not a member of any official church, and, declaring himself a dissenter, he even avoided any contact with organized religion. In opposition to many relatives and to his father-in-law, he refused the religious ceremony for his marriage and the christening of his two daughters. Politically, Abbe may be called a liberal ; he joined in his later years a liberal democratic party. He disliked any extreme nationalism ; he was known even to be in opposition to the policy of Bismarck. Any racial prejudice of 'blood and soil' was quite alien

to his mind. His closest co-operator and friend, S. Czapski, whom he chose as his successor in leading the great organization, was of purely Jewish descent.

Later in life, Abbe suffered from insomnia, which he tried to overcome by an excessive use of drugs In the end his nervous system showed all the signs of exhaustion and at the early age of sixty-three he had to retire. Two years later, in 1905, he died from pneumonia

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It will be widely agreed that the firm of Carl Zeiss occupies the first place among the optical firms of the world. This distinction is merited on the ground of the size of the firm and the variety of its products, coupled with the general excellence of its work Its reputation for many years has been so high as to have given rise to a superstition that any Zeiss instrument is better than a corresponding instrument made by any other firm. In passing, it should be said that this superstition has many adherents in Great Britain, though it is unquestionably and inevitably false Just as other firms have imitated Zeiss instruments, so a number of the finest Zeiss products are more or less copies of designs introduced by other manufacturers, indeed, the firm makes a special point of knowing exactly what its rivals are producing, and to this end makes a practice of purchasing on the open market a sample of all new designs of optical instruments. But the fact that the lead in particular instruments changes at times from one maker to another in no way detracts from the many valuable contributions made by Zeiss to the progress of optical science.

The foundations of the firm's greatness were laid by Abbe. Its reputation in the first place was built on the notable improvements he introduced in the microscope It is interesting to note that from the beginning he followed the plan, which has since proved so valuable to the firm, of publishing papers in scientific journals.

Abbe's theory of image formation in the microscope has been of great assistance to large numbers of microscopists, though many physicists find Rayleigh's treatment of the subject more fundamental and convincing. Among the new glasses produced in an endeavour to secure better microscopic images were some which led to greatly improved photographic lenses—the anastigmats—Zeiss being one of a number of firms to bring out new designs at about the same time.

Although these new instruments were calculated trigonometrically on lines laid down by Abbe, whose aim was to use computers with limited mathematical knowledge, the problems involved were considered in a general way in a treatise planned by S. Czapski. This and a number of later volumes, notably those due to M. von Rohr, are among the best modern works on optics and have added to the prestige of the firm.

The prosperity of Zeiss to-day is in no small measure due to the form of control set up by Abbe—there are no shareholders and no family claims, so that it has always been possible to secure the finest machine equipment as well as to advertise effectively, and to select able men for responsible posts. The great size of the business, which in part was brought about by the large continuous demand for military instruments for the German Army, has enabled research and development to be carried out on a scale impossible in much smaller businesses By way of illustration, the firm studied the problems that would be presented if maps were to be prepared from photographs The outcome was the construction of a series of instruments, used to-day in several countries, for mapping from aerial photographs Some of these instruments are of extreme complexity; despite their great interest and the ingenuity shown in their construction, they have found less favour in Great Britain than in other countries. As another example, possibly built largely for their advertising value, the Zeiss planetaria may be mentioned.

In recent years the firm of Zeiss has built a number of beautifully designed and made instruments of great value to engineers in setting up difficult work accurately, and in other ways. A number of laboratory instruments has also been marketed, but some of these show a tendency which ought to be discouraged. Instead of measurements being recorded on scales which can be defined apart from the instrument, readings are obtained which must be compared with others made on the same type of instrument. Apparently conversion to values obtained in other ways can only be made if the Zeiss apparatus is purchased to experiment with. This course appears to have been adopted deliberately: it tends to create a closed market for instruments in fields where one or two leading investigations have been carried out with Zeiss apparatus. The remedy is clearly in the hands of scientific workers.

This note must not close without reference to the equipment made for ophthalmic opticians and to the firm's spectacle lenses. Apart from such special products as contact lenses and cataract lenses, the Punktal series of lenses is designed to give the best possible vision over a large field with the most varied kinds of visual correction. This is a service of great humanitarian value. The moderate price of these lenses, which are highly finished, shows that the firm can manufacture a wide variety of aspherical surfaces with good accuracy by mass-production methods.

CARBON MONOXIDE AS A HAZARD OF POLAR EXPLORATION

BY PROF. YANDELL HENDERSON AND J. McCULLOUGH TURNER, YALE UNIVERSITY

PETER FREUCHEN, speaking from his long experience in the Arctic, has said recently that "only when modern times came in did the exploration of the Polar regions begin to amount to anything real The invention of the Primus stove did more than anything else. After that came the dog sledge." Certainly modern polar explorers have a great advantage in the hot food and ample supply of drinking water that the Primus stove affords.

THE PRIMUS STOVE AND NANSEN COOKER

Shackleton, in describing the outfitting of his expedition to the Antarctic, says, "a vitally important article of the equipment for the Polar explorer is the cooker and cooking stove. Here again we are indebted to the practical genius of Nansen, who designed the form of cooker that is now invariably used in Polar work The stove was the ordinary 'Primus' burning kerosene vaporized in the usual way This stove is highly efficient and with strict economy one gallon of oil will last three men for ten days, allowing three hot meals per day. This economy is due in a large measure to the qualities of the cooker The form we used consisted of an outer covering of aluminium drawn out of one piece, inside which was a ring-shaped vessel so designed that the heated air could circulate around it. Inside this vessel was the centre cooking pot, and these pots were all mounted on a concave plate of aluminium which fitted over the top of the Primus lamp The middle cooker was first filled with snow or ice, pressed tightly down, the lid was put on and this vessel placed inside the outer, ring-shaped cooker, which was also filled with snow ; over all this apparatus the aluminium outside cover was placed, inverted. The heated gases from the stove, after heating the bottom of the centre cooker, mounted into the space between the two vessels and then were forced down the outside of the ring-shaped cooker by the cover, finally escaping at the lower edge Experiments showed that about 92 per cent of the heat generated by the lamp was used in the cooker, a most satisfactory result, for economy in fuel is of great importance when the oil has to be carried on sledges. . . . Such was the efficiency of the cooker and the stove that, in a temperature of 40 or 50 degrees below zero, the snow or ice, which would be at this temperature, could be melted and a hot meal prepared within half an hour from the time the cooker was first placed on the Primus. The whole apparatus, including the Primus, did not weigh more than 15 pounds."

Such are the advantages of the Primus stove and Nansen cooker. It has only recently been realized that in this combination lurks a danger—that of asphyxiation by carbon monoxide—greater perhaps than any other to which modern arctic explorers are now exposed.

Beside the fatalities, which leave no witness, there have been several narrow escapes. Amundsen was once near death from asphyxiation during his exploration of the North-East Passage. Byrd has recently published an account of how near he came to collapse from a badly adjusted kerosene stove , but in his case fumes additional to carbon monoxide were also involved Stefansson has now focused attention on this hazard and its insidiousness. He reports that, in a snow house that became iced and impervious to gases, one of his Eskimo companions "all at once threw himself backward upon the bed I asked Anderson to see what Tannaumirk was up to—and Anderson fell face forward on top of Tannaumirk. I extinguished the Primus stove. Natkusiak broke away the loose block of snow by which we had a few minutes before closed up the door. He then crawled outside on all fours, but was too weak to stand up I followed him out and had strength enough to stand up. But that was only for a moment and I fell down beside Natkusiak " Fifteen minutes after the door was opened, Anderson crawled out and after another ten minutes, Tannaumirk, "but neither had any realization of what had happened." An hour later three of the party were well enough to go into the house again, but "Tannaumirk was ill throughout the night and into the next day". All the features of this adventure—including the collapse on reaching fresh air—are characteristic of partial asphyxiation and justify Stefansson in referring to it as "the narrowest escape from death we had on our whole expedition".

With this experience in mind Stefansson, in his "Unsolved Mysteries of the Arctic", has discussed the question, "How did Andrée die ?" : and has marshalled the evidence suggesting that that intrepid explorer, and at least one of his two companions, died of carbon monoxide asphyxia. The tragedy, as told in "Andrée's Story", the

official account published by the Swedish Society for Anthropology and Geography, was briefly as follows: On July 11, 1897, after several years of careful preparation Andrée and two companions, Strindberg and Fraenkel, embarked from Spitsbergen in a balloon and floated away over the Arctic sea. Their object was, if possible, to get close enough to the North Pole to permit them to land on the ice and walk back to the coast For that part of the expedition they were fully equipped.

They disappeared for thirty-three years. Then, in the summer of 1930, by pure chance, their remains were found on White Island, a bit of land between Spitsbergen and the Franz Joseph Islands. Enough of their records were salvaged and later deciphered to show that, although they had not attained the Pole, all else had gone essentially as planned until, on their return journey, White Island was reached. There, in some unexplained manner, Strindberg lost his life and was buried; and a day or two later Andrée and Fraenkel appear to have died peacefully in their tent.

Carbon monoxide is believed by Stefansson, Pallin, Sverdrup and others to have been responsible for two of the deaths. The Swedish committee, on the contrary, even after the most thorough investigation, has not felt justified in adopting this hypothesis A critical piece of evidence is lacking; it concerns the Primus stove.

The Primus stove which Andrée and his companions used, was found in good condition and still contained some fuel. But it is uncertain whether the pressure-release valve was open or closed. In carbon monoxide asphyxia, muscular control fails when the blood is about 50 per cent saturated with the gas; unconsciousness occurs at about 60 per cent saturation; and death at 75–80 per cent If then this valve was open, the explorers must have been still conscious and able to move; and their blood was probably not more than 40–50 per cent saturated with carbon monoxide, when they turned this valve and extinguished the flame. In that case even a slight leak of air in and out of the tent or snowhouse would have prevented asphyxiation. If, on the contrary, the valve was still closed when the stove was found, they must have neglected to turn the valve, release the pressure in the stove, and extinguish the flame. The Primus then continued to produce carbon monoxide, until the gradual fall of pressure in its reservoir and cessation of the flow of kerosene extinguished the flame. But before that occurred, the blood of the explorers became 75–80 per cent saturated with that gas; and they died. The question will probably remain for ever undecided.

Conditions for Production of Carbon Monoxide

Whatever the fate of Andrée and his companions may have been, it is important for future explorers to know whether a Primus stove, with vessels above it for cooking and for melting ice, arranged as that of Andrée was, is capable of producing, within one or two hours, sufficient carbon monoxide to render the atmosphere of a small tent or hut lethal, and whether the arrangement may not be altered so as to eliminate this hazard. This we have attempted to determine.

The Primus, although it consumes liquid fuel, is essentially a gas stove. Like other gas stoves, it may produce carbon monoxide in any one or two or all of three ways. If the supply of air to the flame is inadequate for complete combustion, or if the draught in a flue above the flame is insufficient to carry off all the products of combustion, some of the carbonaceous substances in the gas are oxidized only to carbon monoxide, instead of carbon dioxide. The other mode of production of carbon monoxide is not so generally realized, although it is probably quite as common. It occurs whenever a tea kettle is heated over a gas ring with a fairly large flame. That part of the flame which impinges upon the kettle or other vessel is cooled below the temperature requisite for complete combustion; and carbon monoxide is formed and escapes Similarly in gas water-heaters in which the flame plays upon a coil of metal pipe through which the water flows, dangerous amounts of carbon monoxide may be formed. For the health of our cooks, even if on a given consumption of gas the kettle heats more slowly, the rack on which the kettle rests should support it 2–3 centimetres higher than is common now and just above the flame, instead of in it. For safety all gas heaters should have flues

Mere inspection of the diagrams of the Primus stove and Nansen cooker in Nansen's "Farthest North", "Andrée's Story" and other books of polar exploration is sufficient to raise a suspicion that one or even all these conditions for the production of carbon monoxide have vitiated their cooking apparatus. The access of air is not entirely free. The passage through which the burned gas must pass is long and for half its length is against gravity; and the Primus appears to be held so close below the central cooking vessel that a considerable part of the flame impinges upon the vessel.

For the analysis and improvement of these conditions the first question to be decided is whether the stove itself is responsible for a production of carbon monoxide, or whether it is the arrangement of the cooker above it that is to blame. To decide this and related questions we

made use of a galvanized iron box or chamber of one cubic metre capacity in which the stove and vessels were placed for a few minutes at a time An electric fan kept the air in the chamber thoroughly mixed. A metal rod inserted through the wall of the chamber enabled us to turn off the pressure-release valve on the stove and extinguish the flames before the chamber was opened. The oxygen remaining in the air at the end of each test was determined by means of a Haldane apparatus and the carbon monoxide by means of an iodine pentoxide train

The Primus, when well pumped up (50 strokes of the pump) and burning freely, produces a remarkably clean, hot flame When it was tested with no small vessel above it in the cubic metre chamber, we found that it produces virtually no carbon monoxide at all It produces very little even when—after it has burned for three or four minutes—the oxygen of the air in the chamber has been reduced nearly to 17 per cent, at which point the flame is extinguished

When a cooking vessel full of cold water was placed upon the frame over the stove at such a height that the upper part of the flame impinged upon the vessel, some carbon monoxide was produced But the amount was sufficiently small so that the concentration of monoxide in the air in the chamber rose to only 2 3 parts of that gas in 10,000 of air, or 0·02–0 03 per cent, before the oxygen in the air had been reduced nearly to 17 per cent and the flame was nearing extinction From this we infer that a man could sleep fairly safely in a small airtight room, or hut, with a

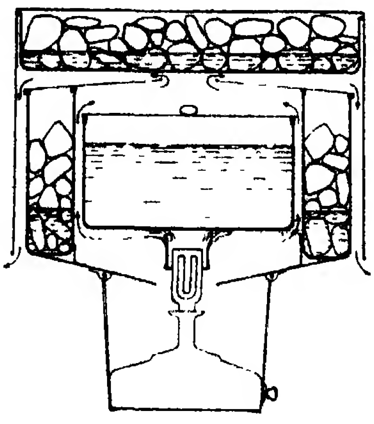

FIG 1.

PRIMUS STOVE AND NANSEN COOKER AS COMMONLY USED IN POLAR EXPLORATION. HEATING EFFICIENCY UP TO 90 PER CENT FOR EACH LITRE OF OXYGEN CONSUMED, 20–30 C.C OF CARBON MONOXIDE MAY BE PRODUCED. IN A SMALL AIRTIGHT CHAMBER ENOUGH CARBON MONOXIDE MAY ACCUMULATE TO ASPHYXIATE A MAN BEFORE THE DECREASE OF THE OXYGEN IN THE AIR TO ABOUT 17 PER CENT EXTINGUISHES THE FLAME OF THE PRIMUS.

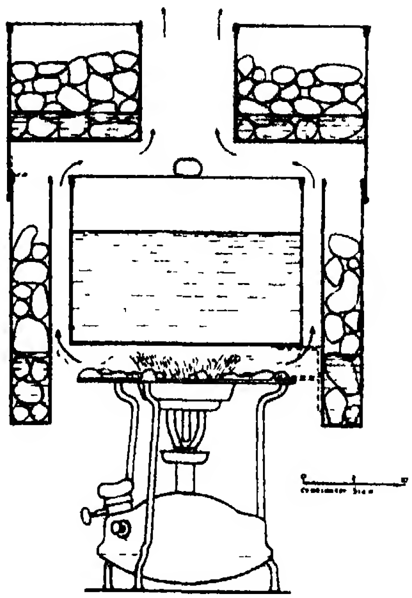

FIG. 2.

PRIMUS AND MODIFIED FORM OF COOKER. HEATING EFFICIENCY ABOUT 70 PER CENT IF ANY CONSIDERABLE PART OF THE FLAME IMPINGES ON THE CENTRAL POT SMALL AMOUNTS OF CARBON MONOXIDE ARE PRODUCED IF THE DISTANCE BETWEEN THE BURNER OF THE PRIMUS AND THE BOTTOM OF THE CENTRAL POT IS SUFFICIENT—3–4 CM —SO THAT THE COMBUSTION IN THE FLAME IS COMPLETE BEFORE THE FLAME IMPINGES ON THE POT, NO CARBON MONOXIDE IS PRODUCED.

Primus and one cooking vessel. The flame would be extinguished by the decrease of oxygen before enough carbon monoxide could be produced to endanger him, although he might wake with a headache He would not be appreciably affected by the decrease of oxygen to 17 per cent (For comparison it may be recalled that a candle is extinguished at about 17 per cent of oxygen, but a Bunsen burner or 'gas ring' burning town's gas is extinguished only at 12 or 13 per cent of oxygen, which are about the amounts at which a man begins to be markedly affected even during a short exposure)

When not only the cooking vessel was placed above the Primus, but also the annular vessel for melting ice was placed around it and an additional pan over it, but without the final cover of the cooker, the flame still burned brightly without the slightest smoke or soot ; and the concentration of carbon monoxide in the cubic metre chamber did not rise appreciably higher than with only one vessel on the stove.

When, however, in addition to the three vessels, the cover was placed over all, as Nansen, Andrée and others have all used the Primus and cooker, the production of carbon monoxide became so considerable that 8–10 or more parts of that gas

in 10,000 of air were developed in the chamber before the flame was extinguished by the decrease of oxygen; and 8–10 or more parts of carbon monoxide in 10,000 of air, if inhaled for more than an hour, can induce a dangerous degree of saturation.

The reasons for the elaborate arrangement of the three vessels and a cover over all, as first adopted by Nansen, were economy and efficiency in the use of fuel. In our hands when well pumped up and burning strongly, the Primus (silent type, large size, capacity 1,100 c.c.) consumes 4–5 grams of kerosene (liquid paraffin) per minute. Taking into account the heat of combustion, the volume of water and the increase of temperature in the contents of the vessels, we have found that when only one vessel is used the efficiency is only 50–60 per cent. When all three vessels are used, but without the cover, the efficiency and economy rise to 70–80 per cent; and with the cover over all, it reaches 80 or even 90 per cent, as Nansen, Shackleton, and others have reported.

With these facts before us, it appears that in Nansen's arrangement (Fig. 1), safety has been too far sacrificed to economy. We suggest, therefore, that the metal cover be omitted, and one of asbestos, or felt, or blanket substituted, with a vent sufficiently wide to offer no obstruction to the escape of the products of combustion, and in addition that some such arrangement of the vessels as that shown in Fig. 2 be adopted: an arrangement suggested to us by Mr. Anthony Fiala.

Even with this arrangement, in which there is a full supply of air and a good draught, some carbon monoxide is produced when the distance between the inner, or cooking, pot and the top of the Primus is so small that some of the flame impinges upon the cold surface of the pot. We find, however, that if this distance is increased so that it is 2 cm. more than the distance now provided between the top of the burner of the Primus and the bottom of the vessel when the vessel is set directly upon the frame of the Primus—or 3–4 cm. in all between burner and pot—no carbon monoxide whatever is produced. With this arrangement, the efficiency of the stove is, however, decreased; and only about 70 per cent of the heat produced by the burning of the fuel is caught in the contents of the three vessels of the cooker.

Whatever arrangement of the cooking and melting vessels may be adopted by future explorers, it would be well, before the expedition starts, to test it by filling the vessels of the cooker with ice and placing it with the lighted Primus in a small room, together with an electric fan to mix the air, and a canary, white mouse, or rat. To be safe, the depletion of oxygen in the chamber should extinguish the flame before the test animal is noticeably affected. With the modified cooker this test may be performed by conducting some of the air from the cooker into a box in which the animal is placed.

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NEWS AND VIEWS

Gold Medal of the Royal Astronomical Society

The Gold Medal of the Royal Astronomical Society has been awarded to Dr. Edwin Hubble, Mount Wilson Observatory, California. Edwin Hubble joined the staff of the Mount Wilson Observatory in 1919. His first work was an investigation of the spectra and luminosity distributions of galactic nebulæ, and he established the now accepted connexion between the light from such nebulæ and the spectra of the stars involved. He proceeded to a general classification of what are now known as extra-galactic nebulæ, and then turned to intensive studies of M31 and M33, which considerably extended the list of novæ observed in them, and he identified Cepheid variables of galactic type as occurring in them. By means of the period-magnitude law for Cepheids he evaluated the distances of these nebulæ, which led in turn to estimates of their dimensions and masses and definitely established not only their extra-galactic nature but also their general similarity to our own galaxy. From this fundamental work followed the recognition of the nebulæ in general as extra-galactic but comparable with our own galaxy in structure. The 'island universe' controversy was thus settled.

Combination of nebular distances with measures of red-shifts (discovered by Slipher but enormously extended by Hubble and Humason) led to the enuncia-

tion of the 'velocity-distance proportionality', often called Hubble's Law. This law underlies all modern theoretical cosmology and the concept of the expanding universe. Recent refinements due to Hubble himself have called in question the interpretation of the red-shifts as velocities; but, in whatever form, the apparent increase of velocity at the rate of about 500 km. sec.$^{-1}$ per 10^6 parsecs is a fundamental world-datum. Hubble's more recent researches have been concerned with the distribution of the nebulæ in space and the discovery of their average homogeneity, modified by a tendency to form groups and clusters; with the determination of the mean density of matter in space, another fundamental constant; with space absorption and obscuration in the galactic plane; with the effects of red-shifts on apparent magnitudes; and with the character of the 'local' group of nebulæ. It may fairly be claimed that the modern picture of the universe of extra-galactic nebulæ is largely due to Hubble's researches. He has recently collected them in a book, "The Realm of the Nebulæ", a work of epic quality. His contributions are characterized by the power and originality of his methods, by his observational skill, by the objective character of his deductions and by the general brilliancy of his results.

The Earthquake in Turkey

THE first official estimate of the earthquake losses was given to the Kamutay on January 11 by the Health Minister, who said that there were 23,131 dead and 7,994 injured and that 29,131 houses had been ruined. Further news of the disaster comes from the affected areas as communications are restored The Susheri district north-east of Erzinjan had been completely cut off for a fortnight except for the dropping of food and medicaments by a squadron of aeroplanes. There were 3,950 dead and 590 injured. It appears that the Malatia Erzinjan railway was not so greatly affected by the earthquake as the Sivas Erzinjan line, though the blizzards and snow affected this line tremendously. According to eye-witness accounts from Rechadiye, there were crevices 400 yards long and several yards wide in different directions Streams and rivulets have changed their courses. At a place 12 kilometres from Rechadiye a mountain had its shape completely altered, giant precipices being formed and roads being blocked. The Yeshil-Irmak overflowed and further threatened Amasya.

Sailors report that between Kerasun and Shebin-Karihisar an entire mountain has subsided. Photographs from Erzinjan show that movement there took place in all directions, as there appears to have been no predominant direction of fall of the columns and other debris. The town of Erbaa near Tokat has apparently suffered almost as much as Erzinjan, and in many places the bursting of drains due to the earthquake and floods has added new terror. It is reported that typhoid has broken out at Fatsa. After-shocks of decreasing intensity have been felt at intervals in the widely separated areas of Samsun, Amasya, Bursa. Kersund, Yozgad, Inebolu, Bolu, Burdur, Isparta, Karahisar, Erbaa, Akhissar, Odemish, Duzic, Sivas, Tokat, Bergama, Smyrna and Kikili, that is from northern to south-western Anatolia, according to a *Times* report.

The entire body of survivors from Erzinjan, numbering 3,200, have been removed to Alexandretta, Mersin, Adana and other towns of Southern Anatolia, except about 130 injured, who have been placed in hospitals in Istanbul, and the surviving military cadets who have been sent to Konia. It is reported that the Government is discussing a proposal to rebuild Erzinjan on its present site, and temporary wooden cottages are to be erected. Dr. G. Van Dyk states that the first pulse to arrive at De Bilt (Holland) after the earthquake was dilatational, and that possible after-shocks were registered there on December 27 at 22h. 44m. 3s. G.M.T. and on December 28 at 3h. 30m. 45s. and 3h. 35m. 15s. G.M.T. We are indebted to Rev. J. P. Rowland, S.J., of the Stonyhurst College Observatory, for a copy of the seismogram of the principal earthquake. This seems to indicate the possibility of three distinct shocks having occurred within the first minute. They appear to have been of increasing intensity and from very nearly the same epicentre.

Drug Standardization

THE Harrison Memorial Lecture was delivered by Mr. A. D. Powell, chief analyst of Boots Pure Drug Co, Ltd., at the evening meeting of the Pharmaceutical Society on January 9. His subject, "Drug Standardization", was chosen, he said, in token of the work done in that connexion by the late Colonel E. F. Harrison prior to his undertaking the responsibilities of his post as chief of the Defensive Gas Warfare Department during the War of 1914–18. Mr. Powell surveyed the progress of standardization from the time when, as a result of the disclosures of the *Lancet* Analytical Sanitary Commission, the Adulteration Act 1860 was passed, and concluded by outlining his own ideas of the desirable features of a satisfactory drug standard.

Mr. Powell put forward five points: (1) The description and principal requirements of strength should be free from ambiguity, and the descriptive paragraph, if it referred to a drug of definite chemical composition, should not be so restrictive as to insist on a particular method of preparation. (2) The degree of purity in terms of the substance, or of an active principle, should be defined wherever possible, unless, as with many organic chemicals, the melting point gave a sufficient indication of a high degree of purity. (3) The tests for purity should be diagnostic, and preferably capable of application under conditions varying within reasonable limits. (4) The number of tests for purity should cover all the impurities likely to be present in significant proportion, but should be limited by this consideration. (5) Tests to detect traces of unlikely impurities, or a redundance of tests for the same impurity, may weaken rather than strengthen a standard. In general, standardization should be definite and free from ambiguous interpretation; this should not

enforce an academically high degree of purity involving artificially high cost of preparation without corresponding advantages in safety and therapeutic activity.

A Pioneer of the Oil Engine

As long as there are oil engines, there will be discussions as to the relative merits of the work of Herbert Akroyd Stuart in Great Britain and of Rudolph Diesel in Germany. Designers of engines to-day utilize the ideas of both, but whereas the name of Diesel has become a household word, that of Stuart is known only among engineers. It was said at the time Stuart died that he "belonged to that rather tragic fraternity of inventors whose achievements have not secured from the world at large the recognition they merited". That his work is fully appreciated in engineering circles was shown by the Diesel Engine Users' Association, which on January 11 held a luncheon at the Connaught Rooms, London, to commemorate the fiftieth anniversary of his most important patents.

After the luncheon, a sketch of Stuart's life and work was given in a paper by Mr. T. Hornbuckle and Mr. A. K. Bruce. Stuart was born in Yorkshire in 1864 and died in West Australia in 1927. He was among the earliest students of the Finsbury Technical College. While engaged at his father's engineering works at Fenny Stratford, Buckinghamshire, he began experimenting with internal combustion engines, and in the years 1886–92 took out nine British patents for improvements. His leading patents were No 7146 of May 8, 1890, and No. 15994 of October 8, 1890. These were taken out in collaboration with C. R. Binney. In that of May 8, 1890, he claimed the novelty of compression ignition. Diesel's patent was not taken out until February 28, 1892. The manufacture of oil engines according to Stuart's patents was taken up by Messrs. Hornsby and Sons, Ltd, of Grantham, in 1891, and Stuart had little more to do with them. Unfortunately, the engines became known as "Hornsby-Akroyd" engines, and in America even as "Hornsby-Diesels". At his death, Stuart left instructions for his papers to be destroyed, but he bequeathed sums of £500 and £700 respectively to the Institution of Mechanical Engineers and the Institute of Marine Engineers for prizes for papers on oil engines.

British and American Civil Engineers

IN September last it had been arranged that representatives of the Institution of Civil Engineers should visit the United States in response to an invitation from the American Society of Civil Engineers, but international unrest in Europe resulted in the cancellation of that visit. Had the visit taken place, it was intended that Mr. W. J. E. Binnie, who was then president of the Institution, should present to the American Society of Civil Engineers a replica of the Myddelton Cup, as a token of the friendly relations which have existed between the two societies. Lord Lothian has now, however, on behalf of the Institution, handed the replica to Colonel D. H. Sawyer, president of the American Society, at a gathering of the members of that Society held in Washington on January 9.

The original Cup was presented to Sir Hugh Myddelton in 1613 by the Worshipful Company of Goldsmiths of London for his services in providing London with a supply of potable water. It remained in the possession of the Myddelton family until 1922, when it was acquired by the Goldsmiths' Company. Lord Lothian has, by completing the ceremony of presentation, cemented the cordial feeling between the two societies and strengthened that part of the bond of international friendship which is based upon the creative genius of the civil engineer in all parts of the world.

Non-Political Work of the League of Nations

A REPORT by the Secretary-General on the work of the League of Nations (July–mid-November, 1939), which has just been issued, is an immediate sequel to the regular report on the work of the League, 1938–39; but is the first of a series which will be published periodically to keep the States Members informed of the progress of the League's work (League of Nations. Report on the Work of the League (Continuation), July–mid-November, 1939. (Official No. A.6(a), 1939.) Pp 62. (Geneva: League of Nations; London: George Allen and Unwin, Ltd, 1939.) 1*s*. 6*d*.). The report shows that with certain exceptions—the European Conference on Rural Life, which was to have met at Geneva in October, for example, had to be postponed *sine die*—the League has been able to carry on, in spite of the War, its essential activities in the non-political fields in which it has been responsible for so much successful and constructive work in recent years. For the development of international co-operation in economic and social affairs, the creation of a Central Committee to direct and supervise the work of the League's Committees dealing with those questions has been recommended and a draft constitution submitted for the approval of the Assembly.

A section in the report on economic and financial questions refers to the meeting of representatives of National Nutrition Committees held at Buenos Aires in October and to measures taken to adapt the publications of the Economic Intelligence Service to the new conditions. Other sections deal with communications and transit, health questions, and traffic in opium and other dangerous drugs. It is interesting to note that maintenance of supervision of this traffic in war-time has been strongly urged by the United States of America, although not a member of the League.

Vital Statistics of a Primitive People

A STUDY of the vital statistics of the lowland Sĕnoi (Sakai) of Perak, Malay Peninsula, by H. D. Noone (*J. Fed. Malay States Mus.*, 15, 4; 1939) is of interest in its bearing on the effect of the inter-racial and cultural contacts of a primitive people on their chances of survival. A generation ago it was regarded as a matter of time only before the then

dwindling pagan tribes of the Malay Peninsula would disappear. The observations which Mr Noone now records, however, suggest that in the group under notice recuperative forces are at work, which enable them at least to hold their own against the effects of Malayan contacts and the adoption by some of their number of the tenets of the Mahommedan faith In the course of an economic and demographic survey in 1936, Mr. Noone found that in fourteen groups with a population estimated at 1,600 the number of children born to the average lowland Sěnoi married woman is 4·15, the model family also being four, but with a tendency to increase The size of the family which occurs so many times as to contribute potentially more to a future generation than any other is five With this figure as a characteristic, there is ground for hope for the future

Fertility, reckoned on the basis of the number of children who grow to maturity and become effective in adding offspring to the group, is assessed on the average survival figure of 3·003, the largest number of deaths before maturity taking place under the age of six years. The sex ratio is 100 females to 107 38 males born ; and this is practically unchanged at maturity at 100 and 107 54 respectively. These figures, taken in conjunction with other data recorded by Mr. Noone, point to the conclusion that while groups in which contacts have been recent appear to enter upon a stage during which the population suffers a disturbance of its reproduction rate, other groups have passed through this stage and have adjusted themselves well enough to be at least as viable as their more primitive and remoter hill cousins

Disease and Race

A CASE which is of considerable interest in its bearing upon the racial incidence and distribution of disease is reported from Egypt by S. Azmy Pasha and A. F. Zanaty of Cairo (*Lancet*, 237, December 30, 1939) The patient in question, a man, thirty-five years of age, who had lived in Cairo for twelve years, but previously to that in the country, was admitted to hospital with anæmia in August 1938 and after discharge was re-admitted in a relapse in 1939. After a fortnight's treatment without improvement, a bone marrow puncture not only excluded an aleukæmic leucosis as well as a plastic anæmia, but also showed megaloblasts typical of Addisonian anæmia. Addisonian anæmia, the authors point out, has a distinct racial incidence It is generally regarded as a disease of Nordic races and as less common among southern races. In America also a higher incidence has been recorded among immigrants from northern Europe (Anglo-Saxon) than among those of Latin extraction. It is also regarded as further supporting this view of racial susceptibility that the Finns, out of all races, are more liable to develop the disease when infested with *Diphyllobothrium fatum*—a parasite which produces a blood-picture indistinguishable from that of genuine Addisonian anæmia. The disease rarely occurs in Asiatics and is unknown in the tropics. In Egyptians it is extremely rare. The authors, after examining hundreds of anæmias, have found only this case now recorded, while another authority has encountered two cases only since 1935.

Demography of Madagascar

IN his inaugural thesis (Thèse de Paris, No. 657 ; 1939) Dr. Félix Randriamanana states that a study of the population of Madagascar since the beginning of the century shows an annual rise, which was very pronounced during the first twelve years but underwent a decline during each of the subsequent twelve years In 1936 the population was 3,777,951 as compared with 2,244,876 in 1900. In 1904 and 1908 various devastating epidemics, especially smallpox, measles, malaria and influenza, had a considerable effect upon the population. The annual birth-rate has increased from 64,847 in 1906 to 88,351 in 1936 ; but the increase is probably more apparent than real owing to the notification of births being carried out more completely then previously.

During 1933-36 the death-rate was 20·7 per 1,000, as compared with 28 5 in Réunion (1933–35), 24 in Egypt (1930–34), 22 in Cochin-China (1931–35) and 15·7 in France (1931–35) During the first year of life the mortality in 1934–36 was 177 per 1,000 births as compared with 83 in France (1930–34) and 206 in Japan (1934). The maternal mortality in childbirth showed a rate of 100 per 1,000 births, this high rate being due to disease and the poor constitution of the mothers. The most prevalent epidemic diseases in Madagascar are plague and malaria at the beginning of summer (December), followed in April by influenza, measles, whooping cough and dysenteries. In June and July pulmonary diseases, especially pneumonia, predominate, followed by influenza, while in September and October more or less severe outbreaks of alimentary diseases are prevalent.

Animal Organisers

Current Science is to be congratulated on presenting to Indian readers a comprehensive résumé of research on organisers ("Organisers in Animal Development", Supp. *Curr. Sci.*, August 1939, Bangalore). There are eight articles contributed by the distinguished investigators, O. Mangold, E. Rotmann, J. Holtfreter, P. Weiss, W Luther, C. H. Waddington, S. Hörstadius and C. M. Child. Four of the articles are in German, the remainder in English. There are numerous illustrations. The subjects discussed range from the general work of organisers during development and the special factors influencing their activities, to collateral fields of research such as the study of regeneration of lost parts and physiological gradients. A certain amount of repetition and overlapping is inevitable in a series such as this, and it would have been helpful if a summary of the articles could have been provided.

The story of the experimental work undertaken by Spemann and his collaborators at Freiburg im Breisgau on blastoporic organisation centres in the amphibian egg is well known in Great Britain. The old 'epigenesis' versus 'preformation' controversy

was thereby revived in a new form. Yet where has it led us? To a slightly better understanding of the laws governing development, but also to obstacles which defy further progress in the present state of our knowledge. For the moment, zoologists have exhausted the subject and await the arrival of a new idea. Some even deny the validity of the organiser theory, and it is possible that much of the work that has been done may be relegated historically to one of those attractive side avenues in science which forms a pleasant rendezvous for a while but is destined to be neglected later because it leads nowhere.

Teaching of Statistics

IN a paper read to the Royal Statistical Society on June 20, 1939, and printed, with the ensuing discussion, in its *Journal* (**102**, 532; 1939), Dr. John Wishart pointed out, among other things necessary for the progress of the subject, the urgent need for a standard treatise on its mathematical side. There are many text-books on practical statistical methods, usually restricted to one particular field of application, such as economics, business statistics, psychology, or biology and medicine, in which the reader has to accept the statements without proof. If a mathematical student asks where these proofs may be found, he may be told "You must look up the original papers, which you will not be able to understand". It is urgently necessary that a text-book should be produced to end this unsatisfactory state of affairs.

Dr. Wishart discussed in some detail what such a text-book should contain, and feared that it was beyond the powers of any one man to produce; he favoured a co-operative venture. However, many will differ from Dr. Wishart on this point, and prefer the incompleteness which may be found in the work of a single writer to the lack of unity characteristic of a book produced by a committee. In the interests of science it is desirable that we should not have to wait indefinitely until the ideal treatise can be produced. Let someone have the courage to make the attempt now; there is no one better qualified for the task than Dr. Wishart himself.

Meteorology in Southern Rhodesia

THE meteorological report of the Department of Agriculture, Southern Rhodesia, for the year ended June 30, 1938, covers the period during which the Northern Rhodesia Weather Service was taken over from the British East Africa Meteorological Service by arrangement with the Governments concerned. After the transfer, the establishment of a new air route in Northern Rhodesia was announced by the Government of that country to replace the existing route via Broken Hill and Mpika, and this led to the setting up of a first-order meteorological station at Lusaka, while arrangements were made to open another at Kasama later. Civil aviation developed to twice its initial volume during the period in Southern Rhodesia, and the Service found it difficult to meet the increased demands for weather reports.

The formula used for the previous ten years for forecasting the seasonal rainfall gave a prediction of abundant rainfall for 1938–39, with a result that could not of course be indicated at the time of completion of this report. The only previous comparable prediction of abundant rainfall was for 1934–35, and was the most conspicuous of only three failures out of the previous nine predictions to forecast whether the rainfall would be above or below the average. On one of these three occasions the predicted and actual departures were so small that it can reasonably be regarded as a successful forecast, making the successes nearly eighty per cent, which is a very satisfactory result. It is stated that the predictions have proved of value, as may easily be credited in view of this high percentage. The report, as usual, includes extensive meteorological tables for a large number of stations for the year, among them those giving hourly values of several items for Salisbury Observatory.

Mistletoe, Magic and Medicine

THE October issue of the *Bulletin of the History of Medicine* contains an excellent survey by Dr. Leo Kanner, of Baltimore, of the history of mistletoe from the earliest times until the present day. The magic virtues formerly attributed to it were as follows: it was regarded as a promoter of grain and fruit harvests; a fattener of live-stocks; an incentive to milk production; a safeguard against ghosts and witches, nightmares and conflagrations, a bringer of luck to farmers, home owners, hunters, warriors, wrestlers and travellers; an agent which forces spirits to reveal their secrets; a discoverer of buried treasures, and a feeder of the mystic mandrake. It was also characteristic of its magic powers that mistletoe was regarded as a panacea, as it was used for the prevention and cure of plague, leprosy, fevers, syphilis, consumption, hæmorrhages, diseases of the heart and lungs, intestinal disorders, poor appetite, skin affections, nervous troubles and, most of all, epilepsy.

On the other hand, mistletoe was sometimes regarded as a baleful plant and was supposed to possess poisonous properties for which numerous remedies were prescribed by Galen and others. In the first half of the nineteenth century all the therapeutic properties of the mistletoe had become discredited, and it was not until 1906 that it became permanently established as a useful drug for the treatment of hypertension and later as a diuretic and styptic.

Tests of a 4,000 kw. Gas-Turbine Set

PROF. A. STODOLA, in *Engineering* of January 5, gives a description and test results of a 4,000 kw. combustion-turbine generating set, recently constructed by Messrs. Brown, Boveri and Co., Ltd., of Baden, Switzerland, for the city of Neuchâtel. The set was built for installing in a bomb-proof chamber for use in emergencies, and consists of an axial-type air-compressor, a combustion chamber, a

gas-turbine exhausting direct to the atmosphere, and an electric generator. "The present-day possibilities of realising a successful gas-turbine, resulting from the improvement of the compressor efficiency on the one hand, and the availability of heat resisting materials on the other hand, would have appeared unthinkable but a short time ago."

When the set is working, with the temperature of the atmosphere about 77° F., air from the compressor is discharged at a pressure of about 60 lb. per sq. in. and a temperature of nearly 400° F. to the combustion chamber. The fuel is gas oil. Only a part of the air is used for combustion, the remainder being used to bring down the temperature of the burnt gases to about 1,000° F., at which temperature they enter the turbine. After doing work in the turbine, the gas is exhausted to the atmosphere at a temperature of about 500° F. The set is rated at 4,000 kw., and revolves at 3,000 r.p.m., producing three-phase current at 50 cycles. The thermal efficiency is 17·38 per cent. The gas turbine, says Prof. Stodola, has many promising possibilities which merit the attention of prime-mover designers and of leaders of industry.

Swiss Watch-making Industry

IN *Swiss Technics*, published by the Swiss Office for the Development of Trade, in Zurich and Lausanne, during November–December 1939, it is stated that although less trade was carried out during the first few months of the year than during the corresponding months of 1938 there was decided improvement in the summer, so that exports to most foreign countries very nearly reached the 1938 figures. This progress would certainly have been maintained had it not been for the War. It would be absurd to give way to despondency with regard to the future of the Swiss watch-making trade. There are two good reasons for looking forward hopefully. The first is the great improvements made by the industry in perfecting watches during the last ten years. The improvements have been continuous.

The 1939 steel watch is proof against fall, shock and damp. It is antimagnetic and does not oxidize. It unites a number of advantages and improvements not found in the best watches made before the War of 1914–18. The manufacturers are not afraid of losing their customers. As an example they give Great Britain, where the demand is increasing owing to the greater need for punctuality. The second reason lies in the organization of the Swiss watch-making industry. The watches are made of good materials and with great technical skill. Quite poor people will always find good watches at a price suited to their purses. Competition which the Swiss might justly have feared has now disappeared. They are therefore prepared to provide the world with the three types of watches produced by a trade that is built up on sound principles: chronometers and precision instruments, suitable for observatories, beautiful high grade watches, and cheaper watches which nevertheless keep good time. It is thus that the Swiss industry faces the great crisis.

Earth Tremors in Belgium

ON January 7 two earthquake tremors were distinctly felt in the district immediately to the east of Mons, one at about 4.30 p.m. and the other at about 8.30 p.m. These were recorded at the Uccle Observatory at 4.29 p.m. and 8.32 p.m. respectively and the epicentre appears to have been near latitude 50° 26′ N., longitude 4° 0′ E. No damage or casualties are reported. It will be remembered that a much stronger earthquake did damage to property and caused injury to ten people in Belgium on June 11, 1938 (NATURE, 144, 950; 1939). On that occasion the epicentre was determined by the chief of the Belgian Seismological Service, Dr. O. Somville, to have been between Audenarde and Renaix, latitude 50° 47′ N., longitude 3° 35′ E. The 1940 epicentre thus appears to have been a little to the south and east of the 1938 epicentre, though any connexion between them is doubtful. The 1938 earthquake had a depth of focus of 45 km. though the 1940 one may have been superficial.

Development of Moscow

A BOOKLET recently issued in Moscow entitled "Moscow in Figures" (London: Russia To-day Press Service) shows the development of the Soviet capital in recent years. According to the figures given, during the last thirteen years the population of Moscow has more than doubled, at present numbering 4,137,000. Moscow is now the third largest city in the world. The number of workers and employees in the factories and institutions of Moscow in 1939 reached 2,300,000, as against 600,000 in 1913. In 1938 there were 117,200 births in Moscow. The city has 175 scientific research institutions in which 9,000 scientific workers are engaged. The higher educational institutions of Moscow have 95,000 students. During the last four years 350 new schools have been built. The number of pupils at present attending the Moscow schools is 608,300.

Hygiene in South China

THE November issue of the *Bulletin de l'Office d'Hygiène Publique* contains an account by Inspector-General Dr. A. Lasnet, the delegate of Algeria, of a sanitary mission sent by the Health Section of the League of Nations to South China in December 1937, six months after the onset of the war between China and Japan. The work of the mission consisted in (1) a campaign against infectious diseases, especially smallpox during the cold season, cholera during the hot season and malaria in the spring and summer; (2) wholesale destruction of insanitary houses, construction of wide sunny streets, proper disposal of excreta, and protection of the water supply; (3) education of the population in hygiene.

Detection of Toxic Gases

LEAFLETS 8 and 9 of "Methods for the Detection of Toxic Gases in Industry", published by the Department of Scientific and Industrial Research

(H.M. Stationery Office, 2s. 6d. each net) deal with phosgene and arsine, respectively. The methods used are colorimetric, the reagents being diphenylamine and p-dimethylaminobenzaldehyde in the case of phosgene, and mercuric chloride in the case of arsine. Full directions for performing the tests are given

Colonial Service Appointments

THE following appointments and promotions in the Colonial Service have recently been made: M. Lunan and C. Mansfield, agricultural officers, Tanganyika Territory; A H. Milne, veterinary officer, Nyasaland; H. W. C. Newlands, veterinary officer, Tanganyika Territory; R. H. Owen, veterinary officer, Gold Coast; C. D. V. Georgi, senior chemist, Research Branch, chief research officer, Agricultural Department, Malaya; R. R. Glanville, senior agricultural officer, Sierre Leone, principal agricultural officer, Nigeria; W. G. Leckie, senior agricultural officer, Kenya, deputy director of agriculture, Basutoland; F A Squire, entomologist, Windward and Leeward Islands, entomologist, Sierra Leone; C A. Thorold, plant pathologist, Kenya, plant pathologist, Department of Agriculture, Trinidad; R G. M. Willan, assistant conservator of forests, Nyasaland, assistant conservator of forests, Cyprus.

Prize Awards of the Paris Academy of Sciences

THE annual public meeting of the Paris Academy of Sciences was held in December, and the customary long list of prize and medal awards for 1939 has been published. Lack of space precludes publication of the complete list of awards, most of which naturally go to French workers, but the names of the following investigators outside France who received prizes may be put on record: Prof. Nicolas Coculesco, honorary director of the Observatory and honorary professor of the Faculty of Science of the University of Bucharest, the G. de Pontécoulant Prize for his studies of celestial mechanics, especially on the development of the perturbing function; Prof. Lucien Dautrebande, of the University of Liège, a Montyon (Unhealthy Trades) Prize of 2,500 francs for his researches during the past twenty years on the toxicology of the vapours of different solvents used in industry; Prof. Pierre Coulouma, of Lille, and director of the Institute of Anatomy of Fribourg, and Léon Devos, of the Faculty of Medicine of Lille, a Montyon Prize of 2,500 francs for their work entitled "Les zones pulmonaires. Anatomie et radiologie chez l'Homme. La lobation et la zonation des poumons. Études d'anatomie comparée chez l'Homme et les Mammifères".

Food Rationing: Special Diets

AT the request of the Ministry of Food, the Ministry of Health, and the Department of Health for Scotland, the Medical Research Council has appointed an expert committee "to advise from time to time on the question whether it is necessary on medical grounds to modify or supplement rations in the case of invalids and other persons on special diets". The following have accepted the Council's invitation to serve on the committee: Sir Edward Mellanby (chairman), secretary of the Medical Research Council; Prof. L. S. P. Davidson, professor of medicine in the University of Edinburgh; the Right Hon. Lord Dawson of Penn; Prof. F R. Fraser, professor of medicine in the British Post-graduate Medical School, London, Prof. H. P. Himsworth, professor of medicine in University College Hospital Medical School, London; Dr. R D. Lawrence, King's College Hospital Medical School, London; Dr. R. A McCance, reader in medicine in the University of Cambridge; Dr. J. C. Spence, Victoria Infirmary, and clinical teacher in medicine in King's College, Newcastle-on-Tyne. The committee will hold its first meeting at once, when the question of diabetic diets will be particularly considered

Announcements

DR. C. H. DESCH retired from the post of superintendent of the Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory, on December 31 last, having attained the normal age limit. Dr. Desch will be succeeded by Dr C. Sykes, of the Metropolitan-Vickers Research Laboratories, who will take up his duties at Teddington on March 1

THE annual general meeting of the London and Home Counties Branch of the Institute of Physics will be held on January 25, in the lecture theatre of the Royal Institution, London, W.1. At the conclusion of the business, a lecture will be given by Dr. H. Spencer Jones, Astronomer Royal, entitled: "The Measurement of Time".

THE next meeting of the Plastics Group of the Society of Chemical Industry will take the form of a joint symposium with the Faraday Society at Caxton Hall, Caxton Street, Victoria Street, S.W.1, on January 26, at 6.30 p.m. The symposium will be entitled: "Molecular Size and Structure and their Influence on the Properties of Plastics". Further information can be obtained from the Hon. Secretary of the Plastics Group, Society of Chemical Industry, Clifton House, Euston Road, London, N.W.1.

THE Hotel Dieu of Quebec, the oldest hospital in Canada, and with the possible exception of one in Mexico, the oldest hospital in North America, has recently celebrated the tercentenary of its foundation.

THE centenary of the foundation of the Belgian Royal Academy of Medicine will be celebrated on September 19, 1941.

THE New York office of the United States Public Health Services is sponsoring the formation of a Society for the Study of Syphilis for all physicians in the city who are interested in the diagnosis and treatment of the disease.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 111. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Evidence for Transformation of Mesotrons into Electrons

ONE of the outstanding questions regarding the mesotron is that of its ultimate fate. Certain properties of this particle are remarkably like those of the hypothetical particle assumed by Yukawa in his theory of nuclear forces and β-disintegration, and this has led to the view that the two may be identical. Within a rather large experimental error they have the same mass, and both are unstable in the free state, having an average life of the order of 10^{-6} seconds. The disappearance of the particle of Yukawa's theory at the end of its life takes place through its transformation into an electron and a neutrino, and it is regarding this that hitherto there has been no evidence of a parallel between it and the mesotron of cosmic rays. In fact, existing experimental evidence has rather gone to show that mesotrons suffer at the end of their life some other fate than befalls the Yukawa particle.

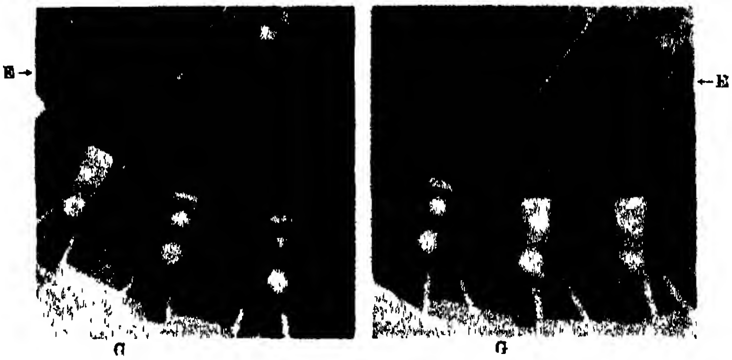

Fig. 2

a AND *b* ARE ARRANGED FOR STEREOSCOPIC OBSERVATION WITH THE NAKED EYE, WHEN USUALLY THE LEFT EYE SEES THE RIGHT-HAND PICTURE.

With the object of obtaining information on this crucial point we constructed a large cloud-chamber (24 in. diameter, 20 in. deep) which, with its large sensitive period and volume, might catch a cosmic ray mesotron coming to the end of its range in the gas of the chamber. A recent photograph taken with this shows a mesotron track terminating in the gas as desired. From its end there emerges a fast electron track, the kinetic energy of which is very much greater than the kinetic energy of the mesotron, but is comparable with its mass energy. This indicates that the mesotron transforms into an electron, in which case the remarkable parallel between the mesotron and the Yukawa particle is taken one stage further. In terms of Yukawa's theory, the phenomenon observed may be described as a disintegration of the mesotron with the emission of an electron, thus constituting the most elementary form of β-disintegration.

Fig. 1

Fig. 1 is a reproduction of one of the photographs of the stereoscopic pair. The dense track *AF* is that of the mesotron, and the faint track *FG* leaving its end, near the bottom of the chamber, is that of the fast electron. It will be noticed that the latter is comparable in density with the tracks of other fast particles which happened to traverse the chamber in the same region. Fig. 2 is a larger reproduction of the stereoscopic pair, showing only the end portion of the mesotron track and the emergent electron (2*a* is not in as good focus as 2*b*). Fig. 3 is a heavily exposed reproduction of the last few millimetres of the mesotron track to bring out its shape though the electron track is thereby nearly lost, and Fig. 4 is an enlargement of the δ-track at *E* to show more clearly its initial direction. The tracks in the present reproductions are much less distinct than in the original negatives and photographic prints, and this particularly applies to the fast tracks (including

FG) and the short δ-tracks, of which there are at least six obvious ones to be seen between *C* and *F* on the original negative.

That the dense track is that of a mesotron follows from its range and curvature, and from the δ-tracks. An accurate estimate of the mass from the curvature is not possible because the scattering which the particle suffers interferes appreciably with the curvature due to the magnetic field. The straightness of *FG* and of neighbouring fast tracks shows that there was no appreciable distortion from air motion. The radius of curvature, ρ, at *B*, measured over *AC* ($\sim$ 20 cm.), is 70 cm., giving $H\rho = 1180 \times 70 = 8 \cdot 3 \times 10^4$. The range beyond *B* is 33 cm in the chamber, corresponding to 41 cm of normal air. These data give a mass, μ, of (250 ± 70) *m*, where *m* represents electronic mass. This is of the same order as previous estimates of the mass of the mesotron, and is sufficiently far removed from the mass of the proton (1840 *m*) to establish the particle as a mesotron. The number and range of the δ-tracks also indicate mesotronic mass, and rule out a proton. In particular the long δ-track at *E*, which in the reproduction in Fig. 3 is seen to be directed nearly forward, has a path-range, *R'*, equal to $0 \cdot 06 \pm 0 \cdot 03$ times the remaining range, *R*, of the heavy particle. This is roughly the range that would be expected for a secondary electron knocked nearly forward by a mesotron with the observed remaining range. It is, however, at least five times greater than the range of the longest δ-track that could be produced by a proton. The latter is approximately $(2^{2 \cdot 4}/1840)R = 0 \cdot 006R$. Regarding the 'scattering' of the track, while it is more pronounced than the *average* effect expected for a mesotron, it is more compatible with the latter than with a proton or any other known particle. The natural 'curvature' of cloud-tracks due to multiple and single scattering is discussed by one of us in a paper now in the press (*Physical Review*). It is there shown that towards the end of its range—last 5 cm. or so—the natural curvature of a mesotron track may well exceed its magnetic curvature in a field of 1,200 gauss. (The 'kink' at *D* contributes little to the average curvature and is possibly more a thinning of the track on one side than a true deflection. The 'single' scattering at *C* appreciably reduces the overall curvature.) The bending of the track in the last 5 mm. or so (Fig. 3) is of interest. It indicates that the mesotron has come to the end of its range, thus discounting the possibility that the photograph represents the production of a mesotron and an electron by a neutral particle. Against this supposition are also the facts that the long δ-track at *E* is initially directed forward, and that the δ-tracks are more numerous in the lower half of the track. Both indicate motion of the mesotron towards *F*.

2 cm

Fig. 3

1 cm

Fig. 4

The curvature of the electron track, *FG*, is very small. Actually there is detectable (Fig. 2*b*), a small curvature in a direction indicating a positive charge, which is also the direction of the curvature of the mesotron. The photograph thus represents a positive mesotron transforming into a positive electron. So far as it can be estimated, the radius of curvature of *FG* is 200 cm. ± 50 per cent, which in the field of 1180 gauss (neglecting any distortion due to air-motion) indicates an energy of 70 Mev. ± 50 per cent. Taking $\mu = 200$ *m*, and assuming that a neutrino takes half the energy, the energy of the electron would be 100 $mc^2 = 50$ Mev.

The large energy of the electron shows, quite apart from Yukawa's theory, that mass has been annihilated—for the mesotron, even if we suppose it has disintegrated before 'stopping', has certainly less than 4 Mev. of kinetic energy. Actually, the large bending of the end of the mesotron track indicates (as already pointed out) that *E* is the normal end of its range, where it has reached too low a velocity to ionize further. In this connexion it is of interest that an upper limit to the lifetime, τ, of this mesotron, since its entry into the chamber, can be set from the fact that the electron track starts from a point certainly not more than 0·4 mm. from the end of the mesotron track. Assuming the mesotron, after it ceases to ionize, to diffuse with gas-kinetic free path (10^{-5} cm.) and thermal velocity (10^5 cm./sec.) this gives an upper limit to τ of $(0 \cdot 04^2/10^{-5} \times 10^5) \sim 2 \times 10^{-4}$ seconds. Actually it is likely that a mesotron, when it stops ionizing, has a velocity of at least 10^7 cm./sec., and a free path considerably greater than gas-kinetic values, so that τ must be much less than the above limit. The average value of τ deduced from the anomalous absorption of cosmic ray mesotrons is of the order of 10^{-6} seconds.

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Large Cosmic Ray Showers and Mesons

IT has been pointed out recently by Bhabha, Carmichael and Chou[1] that a meson may produce a large cosmic ray shower by knocking on an atomic electron in a close collision; this electron then produces a shower by the ordinary cascade process. Previously, Bhabha[2] had come to the conclusion that large knock-on showers are comparatively unimportant; but he had based his argument on the assumption that the scattering of mesons by electrons could be described by the Dirac relativistic theory. However, Massey and Corben[3] have shown that the effect of the spin of the meson is greatly to increase the scattering for high energies of the incident meson and the knocked-on electron. Using Massey and Corben's formula, Bhabha, Carmichael and Chou have shown that the experimental results of Carmichael and Chou[4] can be reasonably well explained, whereas the previous theory predicted too few large showers.

There is, however, another process which has to be considered. In passing a nucleus, a meson may emit a very hard γ-ray, and this γ-ray will start a cascade shower. Since γ-rays and electrons are about equally efficient in producing showers, it is only necessary to consider the relative magnitude of the cross-sections for knocking-on an electron and producing a γ-ray of the same energy, and it appears from calculations which we have recently carried out that at sufficiently high energies the production of a γ-ray is the more probable process.

The direct calculation of the radiation loss by mesons is distinctly complicated. We have, therefore, used the method of impact parameters employed by v. Weizsäcker and by Williams for discussing the

corresponding electron problem. This method requires a knowledge of the scattering cross-section for light quanta by mesons which are initially at rest. We have calculated this, using Kemmer's new matrix formulation of the meson equations[5], which is particularly well adapted to the treatment of problems not involving the nuclear interaction. We have then used this formula, which is too complicated to be quoted here, to obtain the radiation loss in the extreme relativistic case. We find that the differential cross-section for the process in which a meson of energy E collides with a heavy nucleus of atomic number Z and emits a γ-ray the energy of which lies in the range εE, $(\varepsilon + d\varepsilon)E$, is

$$\frac{1}{137}\,\frac{Z^2}{12}\left(\frac{e^2}{mc^2}\right)^2 \frac{E}{mc^2}\,(2-2\varepsilon+7\varepsilon^2)d\varepsilon, \qquad (1)$$

where m is the mass of the meson. (This formula does not apply to very small values of ε.)

The corresponding cross-section for the knock-on process in which the meson gives up a fraction ε of its energy to one of the Z atomic electrons is

$$\frac{\pi}{3}Z\left(\frac{e^2}{mc^2}\right)^2 (2-2\varepsilon+\varepsilon^2)\frac{d\varepsilon}{\varepsilon}. \qquad (2)$$

Hence, for energies greater than about 300 mc^2/Z, that is, about 4×10^9 ev. for air and about 4×10^8 ev. for lead, the emission of a γ-ray is the more probable process. It is, therefore, clear that the calculations of Bhabha, Carmichael and Chou must be modified; the revised theory will give an even greater number of large showers.

It is also of interest to compare (1) with the corresponding formula for electrons, which according to v. Weizsäcker is, with sufficient accuracy,

$$\frac{4Z^2}{137}\left(\frac{e^2}{m_e c^2}\right)^2 \log\frac{137}{Z^{1/3}}\left[\frac{4}{3}(1-\varepsilon)+\varepsilon^2\right]\frac{d\varepsilon}{\varepsilon}, \qquad (3)$$

where m_e is the electronic mass. We see that in spite of the much larger mass of the meson, the cross-section for the emission of a very energetic γ-ray (for which $\varepsilon \sim 1$) is greater for mesons than for electrons, provided that the energy is greater than about $3 \times 10^{13} \log (137Z^{-1/3})$ e.v. Similarly, we can conclude that a γ-ray with energy greater than about 10^{14} ev. is more likely to produce a meson pair than an electron pair, provided of course that the electron theory and the meson theory both remain valid in this region. As a consequence of this we may expect to find cascade showers consisting mainly of mesons and γ-rays high up in the atmosphere. As the energies of the individual particles diminish, the number of mesons will decrease, since electrons will be created instead of mesons when the energies of the γ-rays fall appreciably below 10^{14} ev.

Full details of the calculations will be published when circumstances permit.

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[1] Bhabha, Carmichael and Chou, *Proc. Indian Acad.*, A, **10**, 221 (1939).
[2] Bhabha, *Proc. Roy. Soc.*, A, **164**, 257 (1938).
[3] Massey and Corben, *Proc. Camb. Phil. Soc.*, **35**, 463 (1939).
[4] Carmichael and Chou, NATURE, **144**, 325 (1939).
[5] Kemmer, *Proc. Roy. Soc.*, A, **173**, 91 (1939).

Series in Nuclear Energy-Levels

P. G. Kruger, F. W. Stallmann and W. E. Shoupp[1], investigating the γ-spectrum and the spectrum of the emitted neutrons of the reaction ${}^9_4\mathrm{Be} + {}^2_1\mathrm{D} \rightarrow {}^{11}_5\mathrm{B} \rightarrow {}^{10}_5\mathrm{B}^* + {}^1_0n \rightarrow {}^{10}_5\mathrm{B}$, have found a system of excitation energy-levels of the nucleus ${}^{10}_5\mathrm{B}$ with the values 0·26; 0·50; 0·61; 1·44; 1·93; 2·92; 3·64 and 4·73 Mev., which they interpret as ${}^3D_{1,2,3}\,{}^1S\,{}^1D\,{}^3D\,{}^1D\,{}^3F$ levels.

It is worth remarking that the second, fourth, sixth and eighth terms can be represented by the formula $E_K = 0{\cdot}239\ K(K+1)$ Mev., with $K = 1$; 2; 3; 4; that is, 0·478; 1·434; 2·868 and 4·780 Mev. (by the method of least squares), the deviation of the experimental data being much smaller than the error of 5 per cent admitted by the authors. The formula above corresponds to the law of terms of the rigid rotator in quantum mechanics $E_K = K(K+1)\hbar^2/2J$, where K is the angular quantum number and J is the moment of inertia.

Also, the ratio of the third and the seventh term being 1 : 6 fits surprisingly well into the scheme above with $K = 1$ and $K = 3$. In consequence, we should expect a further term with $K = 2$, and there is such a term (the fifth) at 1·93. The method of least squares leads to 1·84 Mev., just within the limit of the error admitted by the authors, and to $E_K = 0{\cdot}307\ K(K+1)$ Mev., with $K = 1$; 2; 3. The moments of inertia are then $J_1 = 1{\cdot}45 \times 10^{-48}$ and $J_2 = 1{\cdot}13 \times 10^{-48}$ gm.cm.^{2}. Inserting the mass of ${}^{10}\mathrm{B}$, we can calculate a lower limit of the radius of the rotating nucleus to be $r > 2{\cdot}6 \times 10^{-13}$ cm., which appears a reasonable value. With spherical distribution of the particles ($J = \frac{2}{5}Mr^2$), we get $r_{\mathrm{sph.}} = 4{\cdot}15 \times 10^{-13}$ and $4{\cdot}71 \times 10^{-13}$ cm. respectively. That we find two different moments is due either to isomerism of the nucleus ${}^{10}_5\mathrm{B}$ or to a non-spherical symmetry of the nucleus. Thus all terms equal to or greater than 0·48 Mev. of ${}^{10}_5\mathrm{B}$ can be represented as terms of the rigid rotator, and the law is confirmed with eigen values 10^{10} times as great as in molecules.

The term law of the rotator can be applied also to other nuclei. For example, in ${}^{24}\mathrm{Mg}$, excitation levels are known[2] at 2·3, 4·0 and 5·0 Mev. With $E_K = 55{\cdot}5\ K(K+1)$ kv., $K = 6$; 8; 9; we get 2·33, 4·00 and 5·00 Mev. For the moment of ${}^{24}\mathrm{Mg}$ we find $6{\cdot}25 \times 10^{-46}$ gm.cm.^{2}, $r_{\mathrm{sph.}} = 6{\cdot}06 \times 10^{-13}$ cm.

Even for nuclei as heavy as ${}^{223}\mathrm{AcX}$, the law of rotation holds and provides a description of the energy levels. Analysing the α-rays of ${}^{227}\mathrm{RaAc}$, S. Rosenblum[3] has found levels at 30; 61; 81; 135; 174; 197; 235; 247; 288; 313; 335; 386 kv. (some other very feeble ones are not yet determined exactly). With the formulæ $E_K = 1{\cdot}496\ K(K+1)$ kv. and $E_K = 1{\cdot}594\ K(K+1)$ kv., using least squares, we get corresponding levels at 29·9; 62·8; 83·6; 134·6; 175·3; 197·5; 233·2; 248·7; 290·1; 314·2; 334·7; 382·6 kv. These levels are also in conformity with the experimental data of γ-rays. In particular, we find for the highest term:

382·6 — 334·7; 233·2; 210·4; 62·8; 29·9 kv.
differences 47·9; 149·4; 172·2; 219·8; 352·7 kv.

γ-Rays are measured with
47·9; 149·2; 172·7; 219·4; 353·0 kv.

The moments of ${}^{223}\mathrm{AcX}$ come out to be $J = 2{\cdot}18 \times 10^{-44}$ and $J = 2{\cdot}32 \times 10^{-44}$ gm.cm.^{2}

respectively; the radii $r_{\text{sph}} = 1 \cdot 22 \times 10^{-12}$ and $1 \cdot 26 \times 10^{-12}$ cm. respectively.

In accordance with the assumption of equal density, the $\frac{5}{2}$ powers of the mean values of the moments of inertia of the three atomic nuclei described above are proportional to the atomic weight within 1 per cent, namely, 10 : 26 : 223.

A more detailed discussion and the application to other nuclei will be published elsewhere.

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Wave-length Effect in the Reaction of Human Skin to X- and Gamma-Radiation

THE quantitative variation with wave-length of the reaction of human skin to X- and γ-radiation is of both clinical and biological importance. Of especial interest is the determination of the ratio of the biologically equivalent doses, appropriately measured in röntgens, of X-radiation of effective wave-length 110–170 x.u. and of γ-radiation of wave-length 10–20 x.u. It is an accepted clinical observation that the dose of X-radiation equivalent in the production of skin erythema to 1 r. unit of γ-radiation is less than unity, and recent work[1] suggests a value of the order 1/1·3. However, in this and most other studies, the depth dose distribution was very different for the two radiations.

During a clinical investigation with another object, I have examined the skin reactions produced by γ-radiation in which the depth dose at 0·5 cm. was 97–108 per cent; this distribution was attained during the treatment of cases of carcinoma of the lip by means of two-plane moulded applicators. Routine X-ray therapy has made comparison possible and ten of the γ-ray cases were selected together with ten suitable cases receiving X-radiation of approximate effective wave-length 145 x.u. In both groups, the end-point observed was the onset of moist desquamation and the overall time of irradiation was 192 hours. The dosage rates were 0·906–1·26 r./min. for γ-radiation and 28·0–31·5 r./min. for X-radiation; in the former case, the intervals between the exposures were never greater than 12 hours; but in the latter, two 48-hour intervals occurred together with the usual 24-hour intervals. Recent experiments[2,3] show that these differences in dosage rate and time spacing produce an error not greater than 5 per cent in the required ratio. The X-ray apparatus was calibrated using a rice phantom and a Victoreen dosimeter, and the measurements were kindly checked by Dr. D. E. Lea using a free air ionization chamber. The γ-ray intensities were calculated assuming that 1 Imc. hr. = 8·4 r., and the homogeneity of the field at the skin was checked photographically. Clinically similar reactions were observed, among these twenty selected cases, with X-radiation with a mean dose 4,250 r. (minimum 4,200 r., maximum 4,500 r.) and with γ-radiation with a mean dose 5,790 r. (minimum 5,490 r.; maximum 6,500 r.); the reaction did not occur with γ-ray doses 5,200 and 5,350 r. From the results, it is concluded that 0·7–0·8 r. unit of X-radiation of effective wave-length 145 x.u. is equivalent, in the production of moist desquamation of normal human skin, to 1 r. unit of γ-radiation of effective wave-length 15 x.u.

It is important to know whether this result is capable of quantitative explanation in terms of the contribution from photo-electric absorption in the heavier elements present, including the sulphur of the stratum corneum. Tedious but straightforward calculations, including once-scattered radiation, show that the 'physical erythemal effectiveness' W_λ, for radiation of primary wave-length λ, which is defined as proportional to the ratio of the energy absorptions per unit volume in tissue at depth $z \approx 0 \cdot 1$ mm. and in a small air cavity at $z = 0$ half embedded at the surface of a phantom, is given by:

$$W_\lambda = k \frac{(\tau + \sigma_a)_{\text{tissue}}}{(\tau + \sigma_a)_{\text{air}}} e^{-[\mu_c z_c + \mu (z - z_c)]} \left\{ 1 + K(\lambda) \right\},$$

where k is an arbitrary constant, τ and σ_a respectively the photo-electric and scattering absorption coefficients at λ, μ_c the absorption coefficient and z_c the thickness of the stratum corneum and μ the absorption coefficient of the subjacent tissues. $K(\lambda)$ is a slowly varying function of λ and is ≤ 3 per cent for $\lambda = 145$ x.u. This equation has been tested by calculating the value of $\frac{(\tau + \sigma_a)_{\text{tissue}}}{(\tau + \sigma_a)_{\text{air}}}$ for a large number of possible (and improbable!) tissue and nuclear compositions[4,5] using Sauter's formula to obtain τ[6]. From the results, the conclusion must be reached that these physical considerations cannot possibly lead to a value of the ratio less than 0·9, which is significantly greater than that observed.

In seeking an explanation in terms of a chemical process, the participation of excited molecules[7] appears to be supported by the similarity of the photo-chemical changes produced in certain organic compounds by ultra-violet and X- and γ-radiations[8]. Further, the theoretical possibility of a small wave-length effect, but in the opposite direction to that observed, is introduced by the work of Bethe[9], who showed that during the passage of fast electrons through atomic hydrogen the ratio of the probabilities of excitation to ionization processes increased slowly with the energy of the electron. The similarity of the values of the ionization and excitation potentials[10] suggests that the effect may be of the same order for water as for hydrogen. Calculations on this basis (including secondary processes) show that in water the ratio of the number of excitation to ionization processes for radiation of wave-length 12·1 x.u. is $\leq 1 \cdot 05$ times the value for the wave-length 121 x.u.; hence this effect is not likely to be of importance.

These considerations suggest that the observed response of human skin to X- and γ-radiations cannot be attributed quantitatively to its exceptional histological and chemical structure alone, as appears to be the case for the wave-length effect with ultra-violet radiation[11], and it is worthy of note that similar values of the ratio discussed are suggested by recent work on other living cells, assuming that 1 Imc. hr. = 8·4 r.; for example, 0·65 for Drosophila eggs[12], 0·73 for Drosophila pupæ[13]. Comparison of

the ratio for normal and neoplastic tissues would be of great radio-therapeutic interest

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Cozymase in Adrenalectomized Rats

DURING recent years, Verzár and his co-workers have tried to demonstrate that the adrenal cortical hormone plays an important part in the phosphorylations of the body. They have, among other facts supporting this hypothesis, shown that lactoflavine has no B_2-effect in adrenalectomized rats. In these, however, the full vitamin effect is obtained by lactoflavine-phosphate[1]. They have further shown that in adrenalectomized rats the liver contains abnormally small amounts of fixed lactoflavine[2].

In view of these findings, we have thought it of interest to investigate whether the metabolism of cozymase, another prosthetic group carrying the PO_4 group at quite a different position from that of lactoflavine, is influenced by adrenalectomy.

White rats weighing 100–250 gm. were used. They were kept on a diet of white bread and milk. The adrenals were removed transperitoneally under light ether anæsthesia with aseptic precautions. In some cases the gastrocnemius muscle of one side was removed simultaneously and treated as described below.

Controls			Adrenalectomized		
Body weight (gm.)	Weight of brain (mgm.)	Cozymase (γ per gm. brain)	Body weight (gm.)	Weight of brain (mgm.)	Cozymase (γ per gm. brain)
♂ 187	1455	156	♂ 195	1188	94
♂ 202	1154	142	♀ 92	1199	126
♂ 215	1380	119	♂ 217	1320	144
♂ 220	1585	141	♂ 165	1317	151
♂ 160	1183	150	♂ 165	1320	106
♀ 125	1085	115	♂ 145	1255	139
♂ 175	1234	132	♂ 132	1339	87
♂ 196	1343	133			
♂ 202	1401	128			
♂ 245	1388	138			
♀ 123	1244	183			
		Mean 140			Mean 121

When the animals were killed by decapitation after about 120 hours, they were with a few exceptions markedly adynamic. The organs were rapidly removed and placed directly upon a block of carbon dioxide 'ice'. They were weighed and minced in the frozen state. About 1 gm. of tissue was heated in 5 c.c. water just to the boiling point and then allowed to cool at room temperature. It was then kept in the ice-chest. Cozymase was determined in the supernatant fluid by the fermentation test with apozymase in Warburg vessels. The apozymase was standardized with a solution of almost pure cozymase (90–100 per cent).

Experiments with a few animals failed to show any difference between adrenalectomized and control rats in the cozymase content of heart, liver, muscle and kidney. There appeared, however, to be a marked increase of cozymase content of the brain after adrenalectomy. That this was only accidental is shown by the accompanying table giving the values obtained in a series of 11 normal and 7 adrenalectomized rats. The cozymase content is given in γ cozymase per gm. fresh weight. The difference between the means is obviously not significant.

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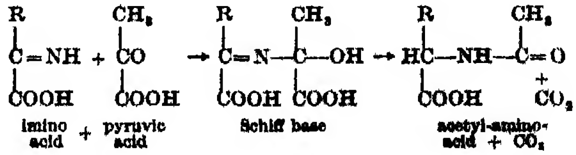
Mechanism of Enzymic Decarboxylation

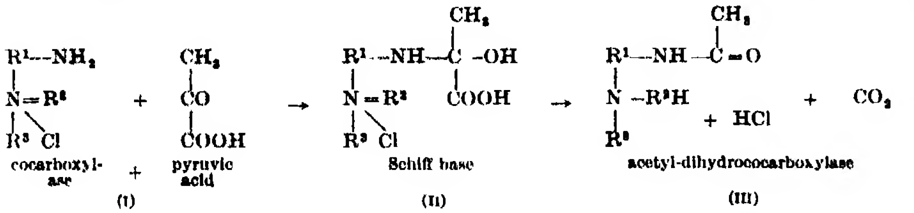
A THEORY of the mechanism of the enzymic decarboxylation of pyruvic acid is suggested, which, though not yet capable of strict experimental proof, is consistent with many recent observations.

Langenbeck[1] predicted the amine nature of cocarboxylase. He showed with various amines serving as carboxylase models that the first step of the catalysis is the formation of a Schiff base. Schiff bases have been postulated as intermediaries in several biological reactions, such as transamination[2] and synthesis of amino-acids[3-6], in the course of which they undergo intramolecular oxido-reductions. Of special interest, because it involves a decarboxylation of pyruvic acid, is the following mechanism of amino-acid synthesis originally proposed by Knoop[3,4] and experimentally corroborated by the recent work of du Vigneaud *et al.*[5,6]:

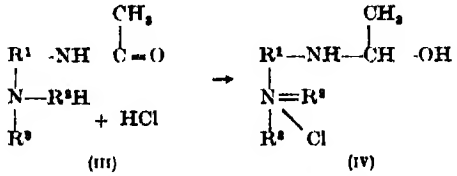


In this scheme pyruvic acid acts as hydrogen donator for the imino acid, being itself oxidized to acetic acid and carbon dioxide.

Besides possessing a free amino group, cocarboxylase contains pentavalent nitrogen which is capable of reduction[7]. The initial steps of decarboxylation may therefore be pictured by the following reactions involving an intramolecular oxido-reduction of the Schiff base primarily formed:



Although the decarboxylating systems of yeast and animal tissues possess the same coenzyme, they differ in that the former converts pyruvic acid into carbon dioxide and acetaldehyde, whereas the latter, in common with certain bacteria, form carbon dioxide and acetic acid by an oxidative mechanism. On the basis of the proposed mechanism a natural explanation is possible if we assume that in animal tissues compound (III) is dehydrogenated to acetyl-cocarboxylase only by a specific carrier[8], whereas in yeast a second intramolecular oxido-reduction occurs resulting in the Schiff base of acetaldehyde (IV)



Besides accounting for the difference between yeast and animal carboxylase, the scheme outlined above is capable of explaining various other facts. It has been observed that acetic acid is very slowly metabolized by isolated animal tissues, yet it has been shown to be formed by the decarboxylation of pyruvic acid which is metabolized very vigorously. An 'active form' of acetic acid has therefore been postulated[9] which can be rapidly metabolized, probably by way of condensations leading to succinic, citric and acetoacetic acids. It is suggested that this 'active form' is identical with acetyl cocarboxylase.

It has recently been reported by Quastel and Webley[10] that the ability of propionic acid bacteria to oxidize acetic acid is greatly enhanced in presence of vitamin B_1. This can be explained by the assumption that this organism possesses the faculty of synthesizing the 'active form' of acetic acid, namely, acetyl cocarboxylase, from acetic acid and cocarboxylase.

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The Releaser Concept in Bird Behaviour

LORENZ[1] has provided a wealth of data and analysis to show that many instinctive acts in birds are 'released' not by the external situation as a whole, but by some characteristic part of it. This greatly assists in explaining the evolution of plumage patterns and rhythmical movements in display in birds, particularly with regard to their 'improbable' and specific nature.

Recent work[2] on the British robin (*Erithacus rubecula melophilus* Hartert) suggests modification of the releaser concept. First, there is the obvious point (with which presumably Lorenz would agree) that the internal state of the bird must also be considered. Thus the copulatory behaviour of the male robin is released when the female assumes a characteristic flattened attitude. But sometimes the male does not copulate when the female assumes this attitude, and sometimes he tries to copulate without the female assuming this attitude; the former can be accounted for by an exceptionally weak, the latter by an exceptionally strong, copulatory drive in the male at the time.

The robin attacks all other robins intruding in its territory, and analysis of the external situation releasing this aggressive behaviour well illustrates Lorenz's point that a characteristic pattern can be the most important factor involved For a mounted specimen of a robin lacking the red colouring on the breast was attacked much less often than a specimen reduced to just a bundle of red breast feathers and lacking head, wings, legs and back. However, analysis showed that no single factor releases aggressive behaviour, for the robin at times attacks (1) various other species of birds of most diverse coloration, chiefly in flight; (2) a mounted robin lacking red on the breast; (3) a bundle of red breast feathers; which three objects have no factor in common. Further analysis showed that the aggressive behaviour could be divided into three main reactions: (1) pursuit-flight, primarily elicited by a small bird flying away; (2) direct striking, primarily elicited by a stationary bird of approximately robin-shape (the presence or absence of red on the breast being unimportant); (3) threat-posturing, primarily elicited by a red breast. Hence the facts could almost be reconciled with the releaser concept provided that the aggressive behaviour was separated into three reactions, each with its own releaser. However, further work showed that this separation, while it undoubtedly existed, was only a tendency, and not a complete division, for, rarely, a mounted red breast was struck and a specimen lacking red on the breast was postured at.

Hence, at least in this case, the releaser concept is too simple. The general implications are important, for they suggest that releasers are not the fundamental units of bird behaviour. Rather, the bird reacts originally to a more general situation. At a later stage (later in evolution if the releasing complex is inherited, later in the life of the individual if it is acquired: this issue is not discussed here), the bird tends to react primarily (but not necessarily exclusively) to a characteristic part of the external situation. The characteristic part or pattern may

then appear to 'release' the behaviour concerned; but it is not (at least always) the sole factor which will elicit the behaviour.

On the above view, releasers are considered to be specialized and secondary. The ability of birds to evolve releasing complexes is clearly of value to the species, and this modification of the concept in no way diminishes the importance of Lorenz's arguments on the nature and evolution of display patterns in birds, since it is agreed that a particular pattern is often the most important (though not necessarily the sole) factor eliciting a particular train of behaviour.

The robin's own mate apparently possesses all the main factors eliciting aggressive behaviour but is attacked extremely rarely and only mildly. This and other facts discussed in the paper cited show the complexity of the problem, which I have been unable to reconcile with any theory of behaviour. The partial separation of the behaviour into particular stimuli with particular responses suggests a mechanistic rather than a holistic interpretation; but the incompleteness of the separation shows a simple mechanistic interpretation to be inadequate.

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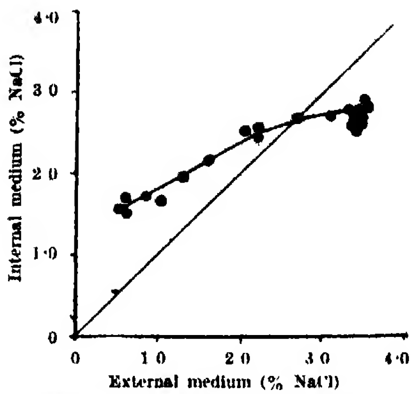
Osmotic Properties of the Common Prawn

IN a previous communication[1] I referred to the homoiosmotic behaviour of *Palæmonetes varians* and its ability to maintain hypotonicity in normal sea water. Further experiments on the osmo-regulatory mechanism of some Crustacea have revealed that the common prawn, *Leander serratus* (Pennant), is also definitely hypotonic when in normal sea water.

The blood of this prawn when taken from sea water has an osmotic pressure equivalent to 2·6–2·9 per cent sodium chloride, the difference between the external and internal media being round about 0·7 per cent. This osmotic pressure is more or less retained by the animals up to dilutions of about 2·5 per cent in the external medium; but in lower dilutions there is a steady decline. In laboratory experiments 0·5–1·0 per cent was the lowest range of salinities at which the prawns could live; and an osmotic pressure equivalent to that of 1·3–1·6 per cent sodium chloride would seem to be the minimum internal osmotic pressure compatible with life.

Compared with Palæmonetes, Leander has a higher osmotic pressure when in normal sea water, and the ability to maintain the osmotic pressure of the blood near the optimum is also much less developed in Leander, as may be seen from the accompanying graph. The difference between the highest and lowest values for the blood of Leander in different dilutions is nearly 1·5 per cent, while the corresponding difference for Palæmonetes is only 0·5 per cent.

Studies on the rate of change of osmotic pressure when prawns are put in dilute sea water have shown that the reduction of the internal osmotic pressure goes on steadily and slowly during the first 14–24 hours, but after the lowest value has been reached there is a slight rise. It is worthy of note that the



RELATION BETWEEN THE OSMOTIC PRESSURE OF BLOOD AND THE EXTERNAL MEDIUM OF *Leander serratus*.
Values in per cent sodium chloride. Abscissæ, sea water; ordinates, blood. Straight line indicates where points would fall if blood and medium were isotonic.

rate of change of osmotic pressure is different in individuals of different sizes. Young prawns 45–65 mm. long respond to external osmotic changes more speedily than larger ones. The ability to live with a low osmotic pressure of the internal medium is also more pronounced in them than in full-grown individuals.

Leander serratus is a littoral species abundant in the southern parts of the North Sea and in the Mediterranean[2]. Though it is able to live in places where the salinity is slightly lower than that of the sea as observed at Plymouth, its habitat is essentially marine; but the osmotic behaviour of *L. serratus* is most unusual for a marine invertebrate. It is of great interest, since certain prawns like *Leander longirostris* M. Edw. are known to migrate many miles up rivers[2] and many tropical species are known to be typical brackish-water and freshwater inhabitants[3]. If the osmotic properties of *Leander serratus* are shared by other species (and it seems very likely), it would explain their peculiar habits and distribution. The physiological evidence would seem to be in favour of considering this species of Leander as having taken secondarily to marine life, since its osmotic behaviour is so unlike that of most other marine invertebrates that have developed powers of osmo-regulation.

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Utilization of Nitrogen by *Ophiobolus graminis*

THE survival period of the fungus *Ophiobolus graminis*, causing the 'take-all' disease of wheat, in infected wheat straw buried in the soil is increased by the application of nitrogen in such forms as calcium nitrate, ammonium nitrate, ammonium

sulphate, ammonium carbonate, and dried blood[1,2]. I have recently suggested[2] that these sources of nitrogen are directly utilized by *O. graminis*, which is thereby enabled to decompose more of the carbohydrate material of the straw, and hence to prolong its existence. Fellows has claimed[3], however, that *O. graminis* is unable to utilize nitrates or ammonium salts, and can assimilate nitrogen only in certain organic forms. His claim is invalidated by the experiments of Padwick[4], using a very similar synthetic medium to that employed by Fellows, but with the addition of a growth-promoting factor. In the presence of a growth-promoting extract obtained from carrots, growth of *O. graminis* was increased four-fold by the addition of 0·15 per cent of nitrogen as sodium nitrate to the medium.

The results of a recent experiment here support those of Padwick. 6-gm. portions of chaffed wheat straw were bottled with the addition of 24 ml. of water or calcium nitrate solution. The calcium nitrate series received 0·25 gm. of nitrogen per 100 gm. air-dry straw. The bottles were plugged and autoclaved for 30 minutes at 15 lb. pressure on three successive days, inoculated with a pure culture of *O. graminis*, and incubated at 25° C. The loss in dry weight in the two series with and without additional nitrogen was as follows (each determination is a mean derived from three bottles):

Percentage loss in dry weight (oven-dry basis)	After 3 months	After 6 months
No additional nitrogen ..	21	23
With 0·25 gm nitrogen as calcium nitrate	27	33

Determinations of nitrate nitrogen in the calcium nitrate series, kindly made for me by Mr. R. G. Warren, of the Department of Chemistry, were as follows:

Sterilized but not inoculated control—240 mgm nitrate nitrogen per 100 gm. air-dry straw

Inoculated and incubated for 3 months—13 mgm. nitrate nitrogen per 100 gm. air-dry straw

Inoculated and incubated for 6 months—0 mgm nitrate nitrogen per 100 gm. air-dry straw

These results show that a pure culture of *O. graminis* growing on sterilized wheat straw can utilize nitrate nitrogen, and hence support the conclusions of Padwick[4].

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Occurrence of Some Off-shore Amphipods in the Littoral Zone

It has been pointed out by various investigators that *Echinus esculentus* L., an animal usually confined to off-shore waters, is found in some places in the littoral zone. Reid[1] showed that it occurred intertidally only on those coasts washed by the North Atlantic Drift, while elsewhere it was confined to deeper waters.

During a period of collecting in August at Oldany Bay Harbour, near Drumberg, Sutherland, *Echinus esculentus* was found intertidally. But it is of interest to note that the following amphipods were also found above low water of spring tides beneath stones and in algæ (Dictyosiphon sp)

Gammaridea: *Ampelisca spinimana* Chevreux, *Harpinia antennaria* Meinert, *Leucothöe spinicarpa* (Abildg.), *Coremapus versiculatus* Norman.

Caprellidea: *Phtisica marina* Slabber, *Caprella acanthifera* Leach.

A search of the literature has so far shown that, with two exceptions, these amphipods have only been recorded in deep water or below the tidal zone. The two exceptions are *C. versiculatus* and *C. acanthifera*, and it is significant that these records are from the Clyde area and Lough Ine, both of which regions are bathed by Atlantic water. This discovery is of interest and suggests that the phenomenon shown by Echinus may be of a more general character than is supposed. A study of the intertidal distribution of other animal groups round the British Isles might prove of value

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Cambridge.
Dec. 15.

[1] Reid, D M, *J Animal Ecol*, **4** 7, (1935)

Scientific and Technical Literature and Information

AMONG the important suggestions made in the editorial in NATURE of November 25 is included the desirability of establishing a new organization which would, among other things, "establish a system of co-ordination among the various provincial libraries of the university and research types". Although it is stated that "the National Central Library is still functioning as a clearing-house for demands for books on loan", it is apparently not realized that this Library is already acting as the national centre for the inter-library lending of books and periodicals, not only between libraries of "the university and research types", but also between libraries of all types, among which must be included our larger public libraries, which frequently contain—and lend—scientific and technical books not available in any other library in the British Isles.

It would appear to be extravagant and unnecessary to set up a new organization to do work which the National Central Library is already doing and for which it has the necessary machinery, even if this is still far from perfect. The service of the Library is used by Government departments, the universities, and almost every library in the British Isles. In normal times it is used also by libraries throughout Europe and elsewhere. The extent of the service is illustrated by the fact that, in addition to the books on its own shelves, the Library has access to more than 21,000,000 books in other libraries in the British Isles. The libraries lending and borrowing through the National Central Library include many of the leading scientific and technical libraries in the country.

It is true, as is stated in the article, that the National Central Library depends upon the Science Library for many books and periodicals—in fact the value of the co-operation of the Science Library cannot be too strongly emphasized—but it is only fair to the other scientific libraries and to the National Central Library's own stock to point out that last year only approximately three per cent of the scientific and technical books lent were obtained from the Science Library.

It is suggested that a union catalogue of war-time holdings of important foreign periodicals should be compiled, but it is not pointed out that, in addition to the entries in many printed union and other catalogues, the National Central Library has tens of thousands of manuscript entries of periodicals in British libraries. This information is constantly being brought up to date.

Experience so far suggests that no great difficulty is likely to arise in buying current numbers of foreign, including German, periodicals through the authorized agents. It may not, therefore, be necessary to establish "a central body" for this particular purpose

As is now well known, the service of the National Central Library is available to any person, provided that he applies for books through his university, public, or other library, and not directly to the National Central Library.

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THE services provided to the scientific and technical research worker by the National Central Library are too well known to need emphasis in the present emergency So far as text-books and pre-war volumes of periodicals are concerned, these services will doubtless find increasing utilization during the War. However, the original editorial more specially concerned itself with the supply and use of current issues of scientific and technical periodicals, especially European publications. The only portions of Colonel Newcombe's memorandum that are relative to this specific problem are his statements that the entries in the National Central Library relating to holdings of such periodicals by British libraries are constantly being brought up to date, and his optimism concerning the facilities for obtaining European periodicals at the present time.

Regarding the first claim, it may be true that, from time to time, the entries relating to holdings of periodicals are revised by the libraries concerned, and copies of the revisions incorporated in the archives at the National Central Library. Nevertheless, it is a well-known fact that contributor libraries to union catalogues of holdings are exceedingly dilatory in communicating information that reflects the deficiencies of their stocks, and this is especially true of current volumes. All librarians naturally hope to fill any lacunæ that arise, and hesitate to revise even their own catalogues until the entries are closed up finally. It is quite certain that, unless the urge to revise entries and betray gaps is stimulated by a prospect that the gaps may be filled from some 'pool', librarians will see no reason to notify the National Central Library of the deficiencies in their holdings of current volumes.

As regards Colonel Newcombe's optimism about present facilities for purchasing European periodicals, it is not irrelevant to point out that already the National Central Library has taken the precaution of removing its records to a relatively obscure site, and has thus provided evidence of a dislocation that may have been temporary in some aspects, but is permanent in others. It can scarcely be said to have facilitated the operations of this particular centre. There are, however, many other aspects of this problem of supply. Many libraries have closed down; many others have seen their periodicals, previously obtained by presentation or exchange, come to an abrupt termination in the middle of volumes; most libraries have to economize in their purchases. The effects of these three factors alone will render the National Central Library's union catalogue of doubtful efficacy in regard to holdings of current issues of European periodicals unless drastic revisions are made therein. Finally, we have to consider the possible extension of hostilities to include those neutral countries that are at the moment serving as sources of supply for these periodicals, the effects of intensive hostilities at sea, and the possibility that sooner or later extensive air-raids over Britain may occur.

THE WRITER OF THE ARTICLE.

Archæology in the U.S.S.R.

IT would be a pity if dislike of the Soviet's foreign or domestic politics should lead men of science to take an unduly gloomy view of the position of archæology in Russia[1]. Prof. Tallgren's last visit to the U.S.S.R. coincided with mine in 1935, and since then many changes have supervened, one may hope for the better. For example, in 1936 a new periodical, *Sovietskaya Archeologiya*, better printed and illustrated than its immediate forerunners, began to appear, to make up a little, admittedly inadequately, for the deficiencies in publication which Tallgren deplored.

The editorial in No. 1 might indeed reinforce his apprehensions—"La lutte implacable contre les écrits pseudo-scientifiques fascistes en matière d'archéologie, le dévoilement incessant des falsifications fascistes des faits archéologiques constituent le devoir direct des archéologues soviétiques qui édifient la véritable science objective"; "La lutte sans merci contre les altérations de tout genre du marxisme-léninisme"—and similar sentiments were discouraging. However, the introduction to No. 2 is devoted to a repudiation of the scholasticism No. 1 apparently approved, a rehabilitation of migrations, the typological method and other devices and an elaboration of the theme "Les recherches historiques exigent une étude approfondie, méthodique et objective des sources premières au lieu que le schématisme corrompait la pensée des historiens, les habituant à mépriser les faits".

Far from making a gulf "completely effective against Western archaeological thought", the Institute for the History of Material Culture in the Academy of Sciences seems to welcome exchanges with archæological societies in Great Britain and with individuals, including the writer. "Gentile", "pre-class", . . . may be inconvenient categories; I doubt if they are really more deceptive than the terms "neolithic",

"Bronze Age" as used in English as late as ten years ago. Prehistoric archæology, being based so largely on a study of tools and weapons, naturally lends itself to a "materialist" interpretation. That does not exclude a study of non-economic activities even in Russia, as for example Zamiatnin's long discussion on fertility rituals in his memoir "Gargarino".

V. GORDON CHILDE.

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[1] NATURE, 144, 971 (1939).

PROF. V. GORDON CHILDE utters a timely protest against "dislike of the Soviet's foreign or domestic politics" leading men of science "to take an unduly gloomy view of the position of archæology in Russia". It was, however, precisely with the view of deprecating any political colouring whatsoever, and of whatever shade of opinion, in scientific matters that protest was made in these columns against the way in which political doctrine under the Soviet Republics had not only affected archæological theory, but had also intervened to check international exchange in scientific research

Attention was then directed to a specific instance of such interference by which an end has been put to Prof. Tallgren's work—this at a date subsequent to that to which Prof. Childe looks for the appearance of some signs of improvement. Even more abhorrent to the spirit of scientific investigation is the regimentation and even 'liquidation' of the individual, from which archæology, with other sciences, in the U.S.S.R has suffered severely. This is no question of like or dislike of a political policy as such.

THE WRITER OF THE NOTE

Points from Foregoing Letters

Evidence, in the form of a cloud-chamber photograph, is given by E. J Williams and G. E. Roberts for the transformation of mesotrons into electrons. This bears out the supposition that the mesotron is identical with the particle assumed by Yukawa in his theory of nuclear forces and β-disintegration.

A. H. Wilson and F. Booth have calculated the probability that, when a fast meson collides with a nucleus, a very energetic γ-ray will be emitted They find that the cross-section is proportional to the energy of the meson, and that for very high energies the energy loss is mainly due to the emission of γ-rays. The bearing of this upon the cascade showers in the atmosphere is discussed.

The known nuclear energy levels of ^{10}B, ^{24}Mg and ^{228}AcX are interpreted by K. M. Guggenheimer as eigenvalues of the rigid rotator, which can thus be applied to nuclei. The moments of inertia are in accordance with the assumption of equal nuclear density.

Quantitative clinical observations by J. S. Mitchell, under conditions with equalized depth dose distribution, show that 0·7–0·8 r. unit of X-radiation of effective wave-length 145 X.U. is equivalent, in the production of moist desquamation of human skin, to 1 r. unit of γ-radiation of effective wave-length 15 X.U. Theoretical considerations suggest that this result cannot be attributed entirely to the exceptional histological and chemical structure of skin.

A mechanism for the enzymic decarboxylation of pyruvic acid is proposed by H. Weil-Malherbe involving the formation of a Schiff base from cocarboxylase and pyruvic acid followed by an intramolecular oxido-reduction leading to acetyldihydrococarboxylase. It is suggested that this compound is oxidized in animal tissues and in certain bacteria by a specific carrier, whereas it undergoes a second intramolecular oxido-reduction with yeast carboxylase resulting in the formation of the Schiff base of acetaldehyde. Acetyl cocarboxylase may be identical with the 'active form' of acetic acid postulated for animal tissues.

Analysis of aggressive behaviour in the British robin by D. Lack shows that it can be divided into three main reactions, each primarily elicited by a different external factor; but this division is only partial While colour pattern is particularly important, it is not the sole releasing factor, and, in general, releasers are considered specialized, and not fundamental, units of bird behaviour.

N. K. Panikkar finds that, like Palæmonetes, the common prawn *Leander serratus* is definitely hypotonic when in normal sea water, though it is less homoiosmotic than the former. Its osmotic behaviour is unusual for a typical marine invertebrate and is of interest when the habits of allied species are considered. The osmotic properties would seem to indicate its having taken secondarily to marine life.

S. D. Garrett reports assimilation of nitrate nitrogen by a pure culture of the fungus *Ophiobolus graminis* growing on sterilized wheat straw plus calcium nitrate.

C. B. Goodhart and Richard Harrison report the occurrence of six off-shore species of amphipods in the littoral zone on the north-west coast of Scotland.

War-time co-ordination of library resources, as advocated in a recent issue of NATURE, is discussed by the librarian of the National Central Library He states that the union catalogue housed in the Library and relating to periodicals in British libraries is subject to continual revision, and that the difficulty of obtaining foreign periodicals in war-time has been exaggerated. In reply to these comments, it is pointed out that revision of entries in union catalogues of periodicals is generally very tardy and imperfect, and that the present period will enhance these imperfections. Reasons are given for anticipating further dislocation and interference with supplies, as compared with peace-time.

RESEARCH ITEMS

New Neolithic Site in Ulu Kelantan, Malaya

THE results of the partial excavation of a rock-shelter at Gua Mĕntĕri on the banks of one of the tributaries of the Sungai Nenggiri have been described by H. D. Noone (*J. Fed. Malay States Mus.*, 15, 4; 1939). The shelter is about 50 yards in length, 20 yards in height, and of an average breadth under cover of 9 or 10 yards. Two trial trenches were dug, but barely 10 per cent of the area available for excavation was touched. Nevertheless, finds were exceedingly numerous. Except where removal was imperative, they were so far as possible covered in again pending the systematic excavation which the importance of the site demands. It affords stratigraphic evidence for the neolithic period, which is urgently needed; and in the human skeletal remains from the burials it will throw light on the at present obscure problem of the population which carried the neolithic culture into Malaya. The grave goods included pots in rows, and disposed in one instance in threes, one inside the other in the inverted position. The eight complete specimens now recovered are unique as evidence of the character of the neolithic pottery, previously known only from sherds, except for a few complete pots from open sites found without associations or stratification. The trial excavations of two trenches revealed three cultural layers, of which the uppermost at a depth extending to 2½ ft. below red clay was rich in relics of a fully developed neolithic, among which three polished axes were found, preceded, it would appear, by an earlier developmental period. This, in turn, was preceded by a cultural layer of an intermediate character marked by the occurrence of numbers of worked flakes of a black stone, which when struck behaves like flint. The earliest cultural level contained palæolithic implements (Hoabinian). In this three intrusive (neolithic) burials with grave furniture were found, the lowest at a depth of five feet below the red clay. Apart from that associated with the burials this lowest level contains no pottery.

A New Drug for Pneumonia Treatment

THE search for new drugs for combating certain infections continues. A few years ago sulphanilamide was introduced and proved of considerable service in the treatment of sepsis due to the streptococcus, and a couple of years ago sulphapyridine (M. and B. 693) was discovered to be of great value for the treatment of pneumonia, cerebro-spinal fever, and other infections caused by the coccoid group of microbes. It is now announced by Science Service of Washington, D.C. that another drug, sulphathiazole, has been developed in the Squibb Institute for Medical Research, New Brunswick, for the treatment of pneumonia. It is stated that it is even more efficacious against this disease than sulphapyridine, that it is safer and has less toxic effect than the latter.

Control of Puerperal Sepsis

AN important memorandum on this subject has been issued by the Ministry of Health (Memo. 226/Med. H.M. Stationery Office. 2*d.* net). Its object is "to explain the nature of puerperal sepsis, how it is spread, and how to identify and group the streptococci responsible". Actually, little is said about puerperal infection in general, the pamphlet being restricted to infections due to the class of microbes known as hæmolytic streptococci, which, however, do not account for more than half the cases of puerperal infection. Details are given of the sources of streptococcal infection, and of the methods of detecting it in patient, midwife or nurse, and of the procedure to be adopted when a source of infection is detected. Finally, a description is given of the laboratory methods required for the isolation and identification of the hæmolytic streptococcus.

Insects of Greenland

STUDENTS of animal distribution will welcome the recent contribution by Kai J. Henriksen entitled "A Revised Index of the Insects of Greenland". Published in *Meddelelser om Grønland* (119, No. 10, 111; 1939), it is obtainable from Messrs. C. A. Reitzels of Copenhagen, price Kr. 5.00. It appears that more than twenty years have elapsed since the last list of Greenland insects was published. During that period both English and Danish collecting expeditions have added materially to what is known of the Greenland insect fauna. The Collembola, for example, have been well studied and now number forty-one species. Only a single species of may-fly and no dragonflies have so far been recorded. Among the fifty-four species of Lepidoptera only four are butterflies. Of particular note is the Noctuid moth *Rhyacia occulta* L., the larvæ of which are often pests of the grassland. In two peat bogs at the head of the Ameralik Fjord an entire layer of pupæ of this insect is recorded, and it bears witness to an outbreak of *R. occulta* in bygone times. Coleoptera are poorly represented and number only forty-four species while some of them, notably Cerambycidæ, are introduced forms. Among the Hymenoptera the Parasitica are relatively very numerous, but little idea can be framed as to their hosts. Records of sixty-five species of the Ichneumonidæ alone are given, whereas the only Aculeata recorded are two species of bumble bees. Of the Diptera some two hundred and seventy-five species are listed, Nematocera being the best represented. Mr. Henriksen's memoir concludes with a bibliography of about eighty references, the majority being to writings in the English language.

Hormones and the Garden

THE discovery of growth-promoting compounds in plants brought new opportunities of horticultural propagation. Marked stimulation in the rooting of cuttings of many species can be brought about, but a curious crop of failures has still to be explained. M. A. H. Tincker, with the assistance of C. H. Unwin, has studied the action of a number of such substances upon a wide range of plants which can be propagated by cuttings. Their most recent results (*J. Roy. Hort. Soc.*, 64, Pt. 12; December 1939) indicate that sixty-one species of those which were tried propagate more readily with treatment, whilst twenty-nine species still defy the propagator. The growth-promoting substances can be mixed with talc and applied satisfactorily in powder form—a great convenience.

Vitamin B_1 (aneurin) alone did not appear to stimulate rooting, but it did increase the percentage of rooted cuttings in a third of the total experiments. The most valuable substances for propagation were found to be (1) indolylbutyric acid, (2) tetrahydronaphthylideneacetic acid, and (3) a mixture of (2) with 3 : 4-dihydro-1-naphthylacetic acid. Some species responded to (1), and others to (2), with equal effect, and the behaviour of (3) approximated closely to (2). The paper gives numerous results of the individual calibre which is urgently needed in this new practice of scientific horticulture

Sex-chromosomes in Cimex

C. D. Darlington (*J. Gen.*, **39**, 101 136, 1939) has examined the behaviour of the sex-chromosomes during meiosis in Cimex. In the male there are 13 pairs of autosomes, a Y-chromosome, together with a variable number of X-chromosomes ranging from 2 to 12 according to the species and the culture At first metaphase, the X-chromosomes do not pair but divide as univalents. At the second division, the autosomes form a peripheral ring and the sex-chromosomes congregate in the middle of the equatorial plate. At second anaphase, the Y-chromosome passes to one pole and usually all the X's pass to the other. This is believed to be brought about by repulsion resulting from a close approximation in the centre of the equatorial plate. Evidence suggested that the centromeres of the autosomes have polarized centromeres at second metaphase, while the X-chromosomes have not. The evolution of the sex-chromosome mechanism in Heteroptera is analysed, and it is shown how the peculiar behaviour of the X-chromosomes results from differential precocity

Effect of X-rays on *Drosophila subobscura*

A. L. M. Christie (*J. Gen.*, **39**, 47–60, 1939) has compared the effects of X-ray radiation on *D. subobscura* with those on *D. melanogaster*. The frequency of lethal mutations induced by X-rays is about equal in the two species, but many more visible mutants occur in *D. subobscura* at a given X-ray dose. It is noteworthy that *D. subobscura* lies between *D. melanogaster* and *D. funebris* in regard to the type of mutation produced. Twenty-eight mutants are described, and a rough map of the X-chromosome, approximately 120 units long, is given.

Mycological Taxonomy

The *Transactions of the British Mycological Society* of October 1939 (**23**, Pt. 3) contains two papers which offer detailed contributions to the exact recognition of fungal species. J. A. Nannfeldt, of the Institutionen för Systematisk Botanik, Uppsala, describes a second batch of fifty type specimens of British inoperculate Discomycetes. This is part of a critical evaluation of species in this group, and deals with an alphabetical arrangement from Cenangium to Velutaria. The correct name of each species in the light of modern knowledge is indicated, and an adequate list of synonyms appears for each. Miss E. M. Wakefield writes the second contribution, on "Nomina generica conservanda". She sets forth the deliberations of the Society's Nomenclature Committee with regard to such generic names as now appear to have little use, after recent findings have excised well-defined groups. Peziza, for example, a generic name established by Fries in 1822 to include a large group, cannot now be used to express more than a few species. The Committee has made definite recommendations for the retention of thirteen names in the lists published as a supplement to the International Rules, 1935. A new species of fungus, *Phleospora Dodonææ*, is also described by R. M Nattrass in the same volume. It was found as a parasite upon a hedge of *Dodonæa viscosa* in Cyprus

Life-Histories of Coprophilous Fungi

Details of the life-histories of coprophilous Pyrenomycetes have been somewhat lacking in the past Literature dealing with the Sordariaceæ and Chætomiaceæ, which are principally concerned, consists largely of descriptions of perithecia, asci and spores, or systems of classification. W. M. Page has grown, upon artificial media, sixteen species belonging to the genera Sordaria, Podospora, Philocopra, Sporormia and Chætomium, in order to obtain more definite information as to their life-histories (*Trans Brit. Mycol Soc.*, **23**, Pt. 3, October 1939). The perithecium originates from a coiled hypha in all but two of the sixteen species The exceptions, two species of Sporormia, are notable in that the perithecium initial divides in three dimensions, probably an indication of evolutionary superiority. Microconidia were observed in *Podospora anserina* and *P minuta*; many other details of spores and spore discharge appear in the paper.

Research in Agricultural Meteorology in India

In addition to the brief summary of the more recent activities of the Agricultural Meteorology Section of the India Meteorological Department that is included in the Department's general report for 1938–39, a more detailed account has recently appeared of the Section's work in 1937–38 in its annual report for the latter period This report includes a description of an improved portable sensitive galvanometer with thermocouple junctions for measuring plant temperatures, made by the Laboratory Apparatus Works, Poona. One of the thermocouples is kept immersed in water of known temperature inside a thermos flask, and the other is inserted into the stem of the plant. When used in the field the instrument is carried on a metal tripod and is levelled with the aid of a spirit-level. A number of soil evaporimeters were in use in which a 5-in. diameter cylinder of soil is kept with its bottom end in contact with the water in a reservoir at a depth of 6 in., or 1 ft., etc., down to 3 ft., in order to study the evaporation from soil surfaces with subsoil water at these depths. Other instruments included an alarum which could be set to sound when air temperature had fallen below a certain level, so that a farmer who installs the device can take precautionary measures against frost damage on hearing the alarum. It has been found that there is an increasing demand for these, vine and sugar growers being among those who have found it useful. Investigations into the disposal of solar radiation and rainfall at the surface of the ground were continued at the Central Agricultural Meteorological Observatory, and also the exchange of water vapour between soils, plant materials, seeds, etc., on one hand and the atmosphere on the other. It was found that all the last-named surfaces yielded moisture to the atmosphere during the hottest hours of the day and received back moisture at night. On the statistical side, sampling studies on the growth and yield of various crops at Poona and other places were continued.

SALT ABSORPTION OF PLANTS

By Prof. H. Lundegårdh,

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In a communication to Nature I outlined an electrochemical theory of salt absorption by plant roots[1] Later, Hoagland and Steward criticized not only the theory itself but also the data on which it was founded[2] From the article by Hoagland and Steward the general reader might get the impression that the experimental basis of my theory is doubtful. I therefore venture to give a short recapitulation of the work of the Institute of Plant Physiology in Ultuna, Uppsala

Since 1927 our work has been chiefly devoted to the problems of salt absorption in higher plants In 1927–32 extensive quantitative investigations[3] on salt absorption showed a wide application of the rules of colloidal chemistry to the process of uptake and transport of cations, and an elaborate study of the antagonistic effects was published in the year 1934 by H. Burström[4]. Also the specific velocity of the anions was demonstrated in earlier papers[5]. The principle of the individual absorption of cations and anions postulates an ion exchange at the surface of the absorbing cell or organ, a well-known fact stated in modern text-books of plant physiology[6]. The existence of such an ion exchange suggested the study of the total ion balance in the boundary between root and medium, including the HCO_3 ions, coming from the expired carbon dioxide After a preliminary study on this balance[7], it seemed necessary to determine quantitatively the respiration during the ion absorption These studies soon showed a marked relation between the intensity of root respiration and the amount of absorbed salts[8]. In view of our previous experience in the individual absorption of ions of opposite charge, we tried to correlate the respiration with the uptake of cations and anions In these experiments one anion, for example, NO_3 or Cl, was combined with a number of cations of different absorption velocity, and also the concentration of the salts was varied. The respiration showed a marked relation to the amount of absorbed anions, and thus the conception 'anion respiration' arose (1933) Apart from the anion respiration the root tissue, as well as all living organs, shows also a fundamental respiration. The total respiration is the sum of the fundamental and the anion respiration[9].

Parallel to the work of Lundegårdh and Burstrom, Steward and Hoagland and collaborators showed that 'aerobic metabolism' is essential to salt absorption. But they were not able to find either quantitative relations or an individual absorption mechanism of anions. The cause of these negative results of Hoagland and Steward is twofold. They limited themselves to a very restricted combination of cations and anions; then their choice of material and experimental technique was inappropriate. In studying quantitatively a physiological process it is very important to choose an organ which is exclusively designed to effect this process. The root system of grass plants is an intensive working absorption machine, which pumps salts into the lower parts (that is, the region of root hairs) and transports them into the upper parts. The bleeding sap which issues from the top of a cut root system contains salts in a much higher concentration than the solution from which these salts are pumped[10]. Hoagland and Steward used either slices of very slowly absorbing storage tissue, or ignored roots which were submerged in the solution. In the former case the ion absorption is too small to render possible an accurate determination of the coupled respiration process, because this will be covered by the variations of a considerable fundamental respiration. In the latter case the root pieces will pump in salts from the solution at the lower end and pump them out again at the top, and the amount stored up in the tissue will for this reason give an incorrect picture of the absorption intensity. Recently, van Eijk[11], at the University of Amsterdam, repeated the experiments of Lundegårdh and Burström on roots of a plant of a type quite different from wheat, namely, *Aster tripolium* Van Eijk confirmed the "Lundegårdh principle of salt respiration". He presented, furthermore, a detailed criticism of Steward's experiments and draws the following conclusion (in translation): "Steward's criticism of Lundegårdh's investigations cannot be sustained, because it is built upon experiments, the method of which is insufficient to demonstrate the anion respiration or on experiments with subjects which *a priori* must cause negative results"[12].

I have repeatedly tried to explain that in the case of the roots of a number of plants the absorption mechanism will function fairly well, if respiration energy is supplied only when anions are absorbed[13]. The protoplasmic colloids and also the free surface of the root cells have negative electrical charge and thus attract cations. This absorption potential will lead to an accumulation of cations in the protoplasm. But this accumulation stops when the absorption surfaces are saturated If now anions are simultaneously absorbed by means of an energy-expending respiration process, these anions will, when they come into the cells, remove cations from the absorption surfaces and cause an accumulation of neutral salts This theory implies also that anions, for example, of organic acids, are produced within the cell itself In this case the cation absorption will proceed, even if no anions are absorbed from the outside But the metabolic activity through which organic acids are produced should not be confused with the anion respiration process which enables inorganic anions to enter the cell. This is a very important distinction. Burstrom has shown that it is possible to distinguish experimentally between the process by which NO_3 ions are absorbed in the root and the chemical mechanism of NO_3 reduction[14]. I showed recently that manganese is a catalyst for fundamental respiration processes, but fails to influence the anion respiration and anion absorption[15]. Burström discovered that manganese is essential for the reduction of NO_3, but has no influence on the NO_3

absorption process[14]. Earlier investigations by Lundegårdh and Burström[17] demonstrated a remarkable difference in the sensitivity of the fundamental respiration and of the anion respiration to cyanide and metallic poisons. Hoagland and Steward seem to have overlooked these results, which prove the possibility of dividing up the 'aerobic metabolism' into at least two distinct groups of processes:

(1) the fundamental respiration complex, which is characterized by its insensitivity to cyanide and the catalytic action of manganese, and

(2) the anion respiration, which is very sensitive to cyanide, but independent of manganese.

Very important is Burström's result that nitrate reduction persisted in crushed root material, whereas the absorption of NO_3 from the solution takes place only if the living organization is intact[18]. This observation conforms with my theory of ion absorption, which postulates the existence of an electrically charged absorption surface and an internal respiration mechanism, which transports the ions to the interior of the cell or organ[19]. The theory assumes a polarity (that is, a one-sided movement of substances) which, of course, will be destroyed if the living substance is crushed.

The complex of fundamental respiration is to be considered as the sum of a number of exothermic chemical processes, which build up cell substance, for example, protein synthesis and growth material of any kind. Some ions, for example NO_3, no doubt participate in both respiration systems: the anion respiration during the uptake, and the fundamental respiration during the reduction and proteinization process. If the cation NH_4 produces an acceleration of the total respiration of the root, as Hoagland and Stewart claim[20], this might be due to an increase in the fundamental respiration complex, because protein synthesis involves a partial breakdown of carbohydrates. Cations which do not interfere with organic chemical processes within the cell, for example, alkali metals and alkaline earth metals, are to a limited extent absorbed from bicarbonates without any increase in the respiration[21].

The coefficient $k = \dfrac{Ra \text{ (anion respiration)}}{A \text{ (anion absorption)}}$ is fairly constant, if A is varied by means of variations in the concentration of one single salt. If the effect of salts with the same anion but different cations is studied, k changes somewhat with the type of cation. As a rule k increases with the absorption power of the cation[22]. The circumstance that the quotient $\dfrac{A \text{ (= absorbed anions)}}{M \text{(= absorbed cations)}}$ also increases with k is an expression of the fact that k is a function of the work which the living organ has to perform in the absorption process[23]. Work can also be expressed in terms of electro-chemistry, and this was the reason why I started a series of observations of the boundary potential between the root and the solution. The results of these investigations have been fully described in two papers[24], and the studies are being continued. Hoagland and Steward also criticize these results.

Hoagland and Steward claim that the potential measurements are performed on "ill-defined" surfaces. I do not know whether they consider the boundary between root epidermis and nutrient solution to be nebulous and unfit for producing an electrical double layer. Speaking in well-known terms of physical chemistry, the existence of electrical potential differences, not only between the root surface and the solution, but also between cell sap and protoplasm, between nucleus and protoplasm, etc., is self-evident. Bio-electrical currents arise everywhere as a consequence of such boundary potentials, if a circuit is closed, and countless measurements of such bio-currents have been made. In an organ the cells are coupled wall by wall and the opposite charges therefore to a large extent neutralize one another. For this reason observed potentials arise, in the majority of the cases, in the boundary between the cell or organ and the electrode. In my experiments the problem was settled by the fact that a sudden change in the electrode solution caused an instantaneous change in the boundary potential, the height of which corresponded with what was electro-chemically to be expected. The boundary between the tissue of the root tip and the solution is consequently well defined, and its behaviour corresponds with well-known laws of physical chemistry.

From a thermo-dynamical point of view, the existence of a boundary potential at the surface of the root must act as a regulator upon the ion absorption (exchange) from the surrounding solution. A number of earlier investigations on animal tissue and also on roots[25] show a distinct relation between respiration and potential. Unpublished results from this laboratory confirm the existence of such a relation and the fact, postulated in my letter to Nature, that a fraction of the root respiration (that is, anion respiration) causes an increase of the positive charge (a lowering of the negative charge) of the root surface, thus facilitating the absorption of anions.

Hoagland and Stewart claim that my theory of ion absorption means an "over-simplification of a very complicated problem". The experimental work of this Institute shows, on the contrary, that the absorption of inorganic ions is far more complicated than earlier investigators, among them Hoagland and Steward, believed.

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[20] *loc. cit.* (1939).

[21] Lundegårdh, *loc. cit.* (1937).

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[23] Lundegårdh and Burström, *loc. cit.*, p. 250 (1933).

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BY PROF. D. R. HOAGLAND, UNIVERSITY OF CALIFORNIA

AND

DR. F. C. STEWARD, UNIVERSITY OF LONDON

Our earlier article directed the attention of the general reader to two independent series of investigations which have been in progress in different laboratories for several years. The combined investigations are extensive and deal with a variety of plant materials and environmental conditions. These apparently divergent investigations yield a consistent general picture of the process of salt uptake in plants, and we are not persuaded by Prof. Lundegårdh's arguments that this picture can be dismissed by the general reader. Our view is that salt accumulation involves vital processes in a more complex and intimate manner than would be suggested by Prof. Lundegårdh's discussion with its reference to principles expressed "in modern text-books of plant physiology" and "well-known terms of physical chemistry".

Prof. Lundegårdh's rejoinder mainly recapitulates his own earlier work. It will be recalled that we had raised the following general points.

(1) Any view of the metabolic processes concerned with salt uptake which has as its dominant feature carbon dioxide production, and especially a limited phase of carbon dioxide production conditioned only by anion uptake, is too restricted. Other vital processes are also concerned, perhaps more fundamentally. Pre-eminent are metabolic properties which are characteristic of cells still able to grow, but which are still difficult of quantitative expression.

(2) There is not, in our view, the sharp distinction in the relation of metabolism to the uptake of cations and of anions, described by Prof. Lundegårdh.

(3) The effects of salts on respiration—undoubted alike for roots and a variety of storage organs—are not related specifically to anion absorption; cations also exert an influence, which is the predominant one for some tissues, and the effects of differential absorption of cation and anion introduce additional factors.

(4) The storage tissue experiments deal with cells uniform in origin, subject to rigid control, in which the capacity for further growth is known. Root systems can never provide such uniform material; but in the experiments of Hoagland and Broyer special methods yielded root material which was replicated with accuracy well within the requirements of the investigation described. By the special control of nutrition the experimental barley plants yielded tissues with a great capacity for salt uptake, apparently much greater than that possessed by the wheat plants used by Lundegårdh.

(5) Neither respiration nor salt uptake occurs uniformly throughout the root system. In calculating an arithmetical relation between respiration and anion absorption Lundegårdh takes no cognizance of this fact, nor of the complications caused by interaction of root and shoot.

(6) Lundegårdh's references to bio-electric phenomena do not elucidate the problem. The surfaces involved were not precisely defined and in any event the origin of such bio-electrical potentials is still controversial.

We may now note those parts of Prof. Lundegårdh's second article which refer to these points.

Lundegårdh states that we did not find the quantitative relations demanded by the concept of anion respiration because:

(a) The choice of treatments was too restricted.

(b) The process of salt uptake must be studied in an "organ exclusively designed to effect this process" and therefore experiments on cells of storage roots and stems are not admissible.

(c) The work of Hoagland and associates on excised roots is subject to the assumed complication that salts absorbed may exude from the single cut surface back into the external solution, so that the amount in the tissue is not a correct measure of that which is absorbed.

We are unable to accept these arguments. To restrict experimental attack on problems of salt uptake to any particular organ, for example, roots of grasses, is an unjustifiable and arbitrary conception. Salt uptake is one of the most general properties of living cells during their growth, and general conclusions must embrace the results of experiments on a wide range of cells and tissues. Our views were based on experiments on roots of barley and potato, a variety of storage roots, stems and modified leaves, growing leaves of dicotyledons and monocotyledons, as well as submerged aquatics and green algæ. While the most intensive investigations have demanded a restricted choice of materials, the general picture we have presented embraces work with all.

Lundegårdh implies that in storage tissues the anion absorption is too small to reveal the anion respiration effect. However, we clearly stated that in experiments that cover a wide range of salts and salt concentrations the *entire metabolism* of the tissue (not merely respiration) responded to the salt treatment. The ion absorption *was* large enough to produce marked effects, which are different in *kind* from those described by Lundegårdh.

Lundegårdh cites no proof that submerged, excised roots continue to exude salt. In any event, Hoagland and Broyer have made numerous studies on exudates of barley roots and find that the salt present in such exudates during the brief duration of the experiments is equivalent only to a very small fraction of the total salt absorbed by an active ("low-salt, high-sugar") root system. Comparisons have also been made between the salt removed from solution by intact plants and by submerged, excised, root systems. With plants having a high capacity for salt absorption, and for the short periods of the experiments, the excised roots and corresponding entire plants absorbed salt in quantities of similar magnitude. The ion uptake, for example, of potassium and easily absorbed anions was very large, and so far as we can find a basis for comparison, was more rapid than that reported by Lundegårdh or, indeed, by any other investigators of salt absorption in plants. As in the case of the storage tissues, we are certain that the roots absorbed salt in amounts and at rates such as to produce striking metabolic effects, although

certain aspects of metabolism may be more prominent in one tissue than in the other.

We have not found anything in Lundegårdh's rejoinder to warrant discarding our view that the implications for the problem of salt uptake of bio-electric measurements are still obscure—we only wish it were otherwise. Amongst those who favour this line of work there cannot be said to be agreement concerning the nature or origin of the phenomena they investigate. Lundegårdh's re-statement still does not convey to us a clear picture of the boundaries which he regards as the seat of the phenomena he measures, that is, whether this membrane is one of cells, for example, piliferous layer (epidermis of Lundegårdh), root cortex, or endodermis separating an external and internal intercellular fluid, or is a protoplasmic boundary membrane, across which the phenomena of ion accumulation in cells actually occur. Such phrases as "root tip" relative to electrode measurements require much more precise definition before they convey any anatomical meaning.

To return to the constant 'k' of anion respiration. It is said to be "fairly constant" for an anion present only as a given salt (although in the experiments with barley roots this function would not be constant even with this restriction). With different cations the value of 'k' is now said to "change somewhat", and it varies also with the ratio of absorbed anions to cations. So versatile a "constant" seems to us to lack utility.

Our purpose in this and our former communication is to suggest to the general reader the complexity of the problem of salt absorption by living cells, and also that the theory of Prof. Lundegårdh has not yet been established and generally accepted by plant physiologists. With regard to the quoted work of van Eijk on the salt marsh composite *Aster tripolium*, we note that it is rather the principle of a salt effect on respiration which van Eijk confirms (with which we are not in disagreement) and not the reality of the special anion effect, which even by van Eijk seems to be regarded as an open question. Van Eijk's values for the quantity "K" do not show that this has a constant value specific for each anion.

Finality cannot be obtained by further exchange of views in the columns of NATURE. Although we hope that the present discussion may serve a useful purpose, its continuance in this journal could not be justified.

STATISTICS AND ENGINEERING PRACTICE

DR. B. P. DUDDING and W. J. Jennett, of the G.E.C. Research Laboratories at Wembley, have contributed a paper on "Statistics" to the Institution of Electrical Engineers which was published on January 5 and should prove useful in engineering applications. Although there was no spoken discussion, the authors have made some minor changes so that it can be read as a contribution to a general written discussion which will be concluded not later than February 5.

The theory of statistics as a distinct branch of science did not begin to flourish until the last quarter of the nineteenth century; in England, the work of Galton and Karl Pearson laid the foundations of the applications of the theory to many fields of science. Research workers in biological sciences and in agricultural industry were the first to turn these more recent advances to practical use. Great interest was stimulated by a series of lectures given by Dr. Shewhart at University College, London, in 1932. Later, the British Standards Institution formed a committee charged with the following terms of reference:

(1) To report on the application and use of statistical methods in standardization and specification of quality; (2) to draw up a short report which would serve to awaken interest in the application of statistical methods on the part of manufacturers and others concerned with problems of standardization and specification; (3) to consider what encouragement is necessary for the development of research on improved statistical methods and their application to industry; and (4) to consider what steps should be taken to provide for co-operation with bodies in the United States of America and elsewhere instituted for similar objects.

Out of this activity also grew the formation of the Industrial and Agricultural Research Section of the Royal Statistical Society. The meetings of this Section have provided opportunities for technicians employed in industry to meet statisticians and for statisticians to meet and discuss with technical people the difficulties which arise in trying to apply statistical methods to the examination of industrial data. Many institutions have been interested in this development. At the present time, there are few industrial products which are not expected to conform with some standard of quality. Measures are taken to ensure that finished products will conform with quality standards demanded by consumers.

The main object of Messrs. Dudding and Jennett was to emphasize the essential statistical nature of many technical problems and the part that chance plays in many technical decisions, and to demonstrate the need for a technique which will give assistance in making deductions from test data.

The following technical improvements and economies accrue to those industrialists who cultivate the statistical outlook and apply statistical methods to the scrutiny of their data. The errors of judgment arising from ambiguities due to the effect of chance, which lead to incorrect action, are reduced. Development work involving reasonably large-scale production can be planned most economically and the results rightly appraised. The efficiencies of the specifications used can be improved, and simple and efficient systematic methods of presenting data requiring daily scrutiny can be readily devised.

The authors explain fully the academic method of considering the frequency distribution of observations by the Gaussian curve, and the use of mean and standard deviations is explained. The importance of the methods given for carrying out specifications which involve sampling is clearly stated.

Numerical examples are included which will help those beginning the study of variance. An example has been given where an experienced engineer lacking statistical knowledge, and the statistician lacking practical knowledge, would probably have come to the same erroneous conclusion. Correct diagnosis of the difficulty in the factory was only possible by a combination of the attributes of the two.

SEVENTY YEARS AGO

NATURE, vol. 1, January 20, 1870

Kant's Views on Space

PROF. T. H. HUXLEY concludes a letter on this subject with . . . "there can be no doubt that that thorough and acute student of Kant, Dr. Ingleby, was perfectly right when he said that Kant would have repudiated the affirmation that 'space is a form of thought'. For in these sentences [quoted from Kant's writings], and in many others which might be cited, Kant expressly lays down the doctrine that thought is the work of understanding, intuition of the sense; and that space, like time, is an intuition. The only 'forms of thought', in Kant's sense, are the categories"

Projected Channel Railways

THE second of a series of three articles on this topic was published. The first article discussed the cultural advantages for Great Britain of closer connexion with the continent of Europe, and proceeded to demolish a fantastic scheme for a railway bridge across the English Channel. The second article dealt with a proposed Channel Tunnel and included a map of the route from the engineers' report issued by the promoters "We are of opinion that it is not an unreasonable proposition, to drive a tunnel under the Channel, but that in some measure it must be a venture. If we are to undertake such a venture to gain a magnificent prize, of immense value to the English and French nations, we must be prepared to meet all ordinary eventualities. . . . The first step towards accomplishing the object would be to obtain a geological section across the Channel . . from actual test of the materials which compose the bed of the Channel."

Meteorological Blockade

SIR WILLIAM THOMSON, F.R.S [afterwards Lord Kelvin] discusses Dr. Balfour Stewart's proposal for a cordon of meteorological stations around a district to keep an exact account of the quantity of water vapour entering and leaving the space over the district in question. "This appears to me a most valuable proposal, which, if well carried out, must have a very important influence, tending to raise meteorology from its present empirical condition to the rank of a science . . the same system of account-keeping ought to be applied to electricity . . . among the many unknown quantities involved, the two departments of the blockade combined will give means for eliminating some and estimating others."

WE notice that an individual was examined on Tuesday at Worship Street on the charge of sweating sovereigns. The details of the case, which are of considerable importance to the public, will be watched with interest. It appears that the coins are dissolved by acid, aided by a battery, and that the loss in some cases equals about two shillings in the sovereign.

IT was announced by Mr. Lockyer at the meeting of the Royal Astronomical Society on Friday last, that the great refractor of 25 inches aperture, constructed by the Messrs. Cooke, of York, is so near completion that it will be erected in the observatory prepared for it at Gateshead early next month.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING AND PHYSICS at the Technical College, Coventry—The Director of Education, Council House, Coventry (January 26)

HEADMASTER for the Pentre Junior Technical School—The Director of Education, Council Offices, Pentre, Rhondda (January 27).

TEMPORARY INSTRUCTOR LIEUTENANTS in the Royal Navy—The Director, Education Department, Admiralty, Whitehall, S.W.1 (January 31)

GRADUATE ASSISTANT to teach ENGINEERING Subjects, PHYSICS and MATHEMATICS—The Principal, Hendon Technical Institute, The Burroughs, N.W.4 (January 31).

ENGINEERING WORKSHOPS INSTRUCTOR to take Engineering Drawing and Allied Subjects (Elementary Mathematics and Mechanics)—The Principal, Hendon Technical Institute, The Burroughs, N.W.4 (January 31).

LECTURER (Grade II) IN DENTAL PROSTHESIS—The Secretary and Registrar, University, Bristol (February 10)

DIRECTOR OF RESEARCH of the Linen Industry Research Association—The Secretary, The Research Institute, Lambeg, Co. Antrim (March 1)

JUNIOR ASSISTANT CHEMISTS—The Secretary, Linen Industry Research Institute, Lambeg, Co. Antrim.

ENGINEER for the Public Works Department of the Government of Hong Kong—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9006)

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Bureau of Animal Breeding and Genetics. Animal Breeding in the Light of Genetics. (Seventh International Genetical Congress, Section D.) Pp 78 (Edinburgh and London: Oliver and Boyd) 3s [2812

Department of Scientific and Industrial Research Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research, for the Year 1938. Pp iv+84+4 plates. (London: H.M. Stationery Office.) 1s. 6d. net. [2912

International Journal of Agrarian Affairs. Vol. 1, No. 1: The Problem of Surplus Agricultural Population Pp. 96. (London: Oxford University Press.) *3s. 6d. net.* [21

Thirtieth Report of the Commissioners of His Majesty's Customs and Excise for the Year ended 31st March 1939: being the 83rd Report relating to the Customs and the 82nd Report relating to the Excise. (Cmd 6098) Pp. 205. (London H.M. Stationery Office.) 3s. net. [21

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Congregation during the Academical Year 1938–39. Pp. 22. (Durham: The University.) [81

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 690: The Acidic Properties of Peat and Muck. By Irvin C. Feustel. Pp. 42. (Washington, D.C.: Government Printing Office.) 10 cents. [2812

Bulletin of the American Museum of Natural History. Vol. 76, Art. 8: Body-Forms of the Black Marlin (*Makaira nigricans marlina*) and Striped Marlin (*Makaira mitsukurii*) of New Zealand and Australia. By William K. Gregory and G. Miles Conrad. Pp. 443–456+plates 3–6. (New York American Museum of Natural History.) [2812

Chinese Medical Association. Special Report Series No. 12: Nutritional Studies in Shanghai. By H. C. Hou, P. G. Mar, T. G. Ni and B. E. Read. Pp. iv+92. (Shanghai: Chinese Medical Association.) 2 dollars; 4s. [2912

Madras Government Museum. Guide to the Archæological Galleries: An Introduction to South Indian Temple Architecture and Sculpture. By Dr. F. H. Gravely, C. Sivaramamurti and other Curators. Pp. viii+46+4 plates 8 annas. Illustrations of Indian Sculpture, mostly Southern: for Use with the Guide to the Archæological Galleries. By Dr. F. H. Gravely and C. Sivaramamurti. Pp. iv+46 plates. 1.8 rupees. (Madras: Government Press.) [21

Journal of the Indian Institute of Science. Vol. 22A, Part 19: Synthetical Investigations in the Thujone Series, Part 8: Synthesis of *Iso*-Thujone. By P. C. Guha and A. Kuppusami. Pp. 249–254. 10 annas. Vol. 22A, Part 20: Synthetical Investigations in the Camphane Series. Part 5: Synthesis of Manasse's Ketonic Acid, $C_{10}H_{16}O_3$, from Camphorquinone; 2:2:3-Trimethyl-*cyclo*hexane-4-one-Carboxylic Acid. By P. C. Guha and Debabrata Das Gupta. Pp. 255–262. 12 annas. (Bangalore: Indian Institute of Science.) [21

Government of India: Meteorological Department. Magnetic, Meteorological, Atmospheric, Electric and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1937 under the direction of Dr. K. R. Ramanathan. Reduced and tabulated under the direction of Dr. K. R. Ramanathan and Dr. S. R. Savur. Pp. A76+B44+C4+D14+5 plates. (Delhi: Manager of Publications.) 14.14 rupees; 23s. [21

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SCIENCE AND EDUCATIONAL POLICY

THE statement of the Prime Minister that the aims of Great Britain during the present struggle must be sharply differentiated into war aims and peace aims amounted to much more than a reply to the demands for a clarification of what is to be our attitude when the War comes to an end It is essential, however, that the wider peace aims should be constantly reiterated in order that they may remain fixed before our eyes. It would be more than regrettable if the ideals of freedom, liberty and equality that have led the Allies to take up arms were lost sight of even temporarily in our efforts to defeat the enemy Mr J. B. Priestley, in speaking of the drama, said recently that a momentary blurring of the objects for which we are fighting would be enough to invalidate our reasons for having gone to war

A real and immediate problem which deserves consideration is whether a long-term national policy of scientific education ought not to be introduced into the schools of Great Britain. It is becoming more and more apparent that the provision of scientific education is far from being scientifically planned, a matter which could be adjusted by closer co-operation between scientists and educationists. Here the different forms of educational institutions would have to be considered not separately but as components of a system which aims at the development of beings whose lives are continuous processes. In this respect the insistent demand raised in the report of King George's Jubilee Trust* for continuation classes for all up to the age of eighteen should receive adequate consideration. The Industrial Revolution, the growth of the physical sciences, the mechanization of ways of living with its consequences in transport, communication and manufacture have all combined to produce an environment in which educational equipment in many cases leaves the ordinary citizen thwarted and helpless The ideal of science is the pursuit of objective truth , if material progress is to continue, it is essential to keep this ideal clearly in view in the prosecution of measures whereby scientific truths might be made to contribute to human welfare.

Reflection on the standard of living of masses of the population makes one painfully aware that the applications of well-established scientific truths are not being carried out in an efficient and objective fashion There is no need to emphasize the fact that science must look for a policy which will in no respect imitate the nationalistic efforts of countries where scientific truths are distorted to conform to ideological needs. Various factors indicate that the population of Great Britain is likely to decrease during the next few years. If, as compensation, the quality of the people is to be improved, scientific workers, and especially those in the biological field, should decide the paths upon which the course of science development is to be guided.

Co-operation between scientific workers and educationists led to marked improvement in living standards of the nation while we were at peace. In these times of stress and anxiety, the value of the wider extension of scientific methods of thought and practice is apparent. The national effort will only reach its maximum when due regard is paid to the health of the nation as a whole In this connexion, it is doubtful whether scientific workers are being allowed to play a sufficiently active part in the various schemes of food production and control. Much could be done, especially in the

* "The Needs of Youth". By A. E. Morgan. (London: Oxford University Press, 1939.)

reception areas, by the introduction of classes for teachers and youth leaders, where the specific problems bound up with evacuation could be discussed The Workers' Educational Association, the Townswomen's Guilds and other bodies have already sponsored classes of this type. These could be usefully extended. The rural community councils and women's institutes provide means whereby scientific practice could be more quickly transferred to non-urban communities

One aspect of this policy would be the need for greater and more effective co-operation between scientists and educationists in deciding upon the content of the general school curriculum, and in particular the science part itself. The Science Masters' Association has approached the problem in the right manner by taking steps to revise examination syllabuses in liaison with university staffs, this has resulted in the publication of reports on various subjects, including the recent one on the teaching of general science. But their scope of action is necessarily limited, and the origins of the present conflict indicate the necessity for a re-orientation of the school science content if the ideals expressed in the Spens Report are to be given effect The Consultative Committee responsible for this report has in no wise exaggerated the case when it states that even the possibilities of science teaching have not yet been fully apprehended

One of the more urgent problems that calls for investigation is the need for a clearer definition of the concept of social biology as an educational medium Another avenue that could be explored with profit by scientists and educationists is the present rating of science in many school syllabuses. Apart from its use in technical and vocational training, science as an educational subject often receives poor recognition. In the Common Entrance Examination to Public Schools, for example, Latin still remains as the symbol of what is to be desired in the shape of compulsory attainment, while science is relegated to a minor, optional position This specific instance is but a general symptom of a condition which is more widespread than is obvious on superficial examination Such an assessment often fails to accord both science and industry their true social worth, while much useful talent is frequently diverted elsewhere. Further, in many schools science is considered to play little or no part in the process of character training; such restrictions lead to numerous psychological problems, centred upon the true worth of science, which have no real foundation. If some of these difficulties are to be adjusted, considerable effort will have to be exerted by scientific workers with an interest and enthusiasm that is based upon inflexible moral purpose and a real concern for human progress.

The difficulties encountered in the development of the Colonial Empire merit special attention Until very recently the significance of the tropical and sub-tropical Dependencies has been viewed as through a glass, darkly. It is a tribute to our administrators that, despite this lack of interest in Great Britain, in at least some parts of the Empire it is more than probable that education is being approached in a spirit that approximates more nearly to being truly scientific than is the case nearer home In some places excellent results are being obtained, and the part played by educationists in the establishment of stability in these rapidly evolving Colonies demands the widest recognition. The recent extension of the college for native African students at Makerere in Uganda is a new milestone in colonial development. In the Colonies, greater interest shown by scientific workers would produce even more striking results.

It has yet to be decided whether positions of importance in the Colonies should be allocated to men and women who have specialized only in one or two branches of science Evidence comes to hand constantly to show that, whereas specialists are essential for university teaching and research posts, for general educational purposes the Colonies need people with a wider scientific training, preferably with a biological bias; it may be added that there is a body of opinion in Great Britain which maintains that this is also applicable to home conditions. For the Colonies, undoubtedly, greater attention should be paid to the recruitment of those whose task it will be both to undertake teaching duties themselves and to train and inspect native teachers in the Colonial Empire.

The planning of programmes for the present year is more than hazardous at this time, but, because of the rich opportunities which are presented, it is to be desired that responsible authorities will make at least tentative preparations for the holding of 'refresher' courses and vacation schools wherever this is possible. In general, 'refresher' courses in science have either been concerned with imparting pure academic or technical knowledge, or have served their purpose in spreading scientific knowledge and principles to

a wider audience. The latter would probably be the more fruitful course to be adopted while we are at war. Opportunities might be provided during the approaching summer for teachers, club leaders and other youth workers to be able to make refreshing contacts with members of their own professions, and to obtain valuable help and guidance from leading scientific workers and educationists. For various reasons, it seems unlikely that the Board of Education will be able to proceed with its admirable courses in science during the summer, so that the opportunities provided by other organizations would be of inestimable value.

MEMORIES OF A PALÆONTOLOGIST

Some Memories of a Palæontologist
By William Berryman Scott. Pp vi+336. (Princeton, N.J.: Princeton University Press; London Oxford University Press, 1939) 17s 6d. net

DURING the past sixty years, American palæontologists have taken a very large share in adding to our knowledge of fossil mammals They have not only made remarkable discoveries on their own continent, but have also worked in close association with their colleagues in other countries.

Among them during the whole of this long period, Prof. William B Scott, of Princeton University, has been especially active, and few have ranged over a wider field. Since 1877, when he made his first collecting expedition to the West with his classmate, Henry Fairfield Osborn, until the present day, when he has joined Prof Glen L. Jepsen in preparing a large memoir on the Oligocene mammals from South Dakota, he has travelled and engaged in research with tireless energy. His experiences therefore have been many and varied, and while occupied with his own technical problems he has seen much of the world in general He has now recorded some of his memories in an attractive volume which will be welcomed by all who are interested in the ways of life of scientific men.

Prof. Scott, through his mother, is a great-great-great-grandson of Benjamin Franklin, and he began life at Princeton in unusually intellectual surroundings. From the beginning his inclinations were towards natural science, and when he was a schoolboy his interest in geology was first roused by his grandfather who made some casual remarks to him about the nature of coal. At Princeton he studied under Prof. Arnold Guyot, whom he eventually succeeded in the professorship of geology. In London he attended Prof. Huxley's course in comparative anatomy; at Cambridge he studied embryology with Francis M. Balfour; and at Heidelberg he spent much time in research under the direction of Carl Gegenbaur. He was thus well equipped for both geological and biological work, and he gives many interesting reminiscences of his teachers and distinguished fellow students His visits to Europe also brought him into contact with other leaders in geological and biological science of whom he records impressions His experiences of England and Germany seem to have been particularly happy.

Prof. Scott has much to say of life in Princeton, where he witnessed the growth of the old College into the University He describes his expeditions to the West to collect fossils, beginning in the days when the Indians were still troublesome; and he makes many references to the rivalry of Cope and Marsh, who were his predecessors in the field. There are also observations on South Africa, which he visited with the British Association in 1905; on Panama, which he visited in 1911; and on Spain, where he attended the International Geological Congress in 1926

Prof. Scott's most important work outside North America was his organization of the Princeton University Expedition to Patagonia under Hatcher and Peterson during 1896–99. Between 1901 and 1931 he edited the series of handsome volumes which record the results, and he himself contributed most of the descriptions of the fossil mammals. In 1901 he visited the Argentine so that he might study and photograph the fragments of similar fossil mammals in La Plata which had already been described by Ameghino and others. Reminiscences of this journey occupy an interesting chapter.

During the past few years Prof. Scott has not only continued the researches on Oligocene mammals already mentioned, but has also published new editions of his well-known "Introduction to Geology" and "History of Land Mammals in the Western Hemisphere". He has rewritten the greater part of the latter book and made it an indispensable up-to-date work of reference. Now that he is an octogenarian, he adds to our indebtedness by giving us a stimulating collection of memories, which show how wide may be the outside interests of one who devotes himself to palæontology. ARTHUR SMITH WOODWARD.

PLANT VIRUS DISEASES

Plant Viruses and Virus Diseases
By F. C Bawden (A New Series of Plant Science Books, Vol 5) Pp xii+272 (Leiden · Chronica Botanica Co, London · Wm Dawson and Sons, Ltd., 1939) 7 guilders

THE earlier investigations of virus diseases of plants were attempted by the standard methods of the plant pathologists, and failed to reveal the cause of the disease, or to elucidate the nature of the infective agents These methods have been supplemented by a technique of the widest biological basis, including that used by biochemists and physicists to investigate proteins and other compounds of high molecular weight. The author, with his colleagues, has played a prominent part in the isolation, purification and chemical recognition of nucleoproteins obtained only from infected plants His hypothesis, freely accepted to-day, considers the nucleoproteins to be the viruses, this forms the theme of his book, which might with advantage have been entitled "Recent Research on the Nature of Plant Viruses" Thus it differs, particularly in outlook but also in treatment, from other recent text-books of virus diseases which are primarily concerned with the economic host plants, this one especially considers the infective agents.

In the introductory pages the author criticizes with acumen suggested schemes of classification or nomenclature based largely on records of host plants infected, in later chapters a classification based on the actions and properties of the viruses is put forward Such a desirable change can only take place when sufficient knowledge of the viruses is gained, whereas little benefit and considerable confusion may arise from reshuffling an artificial system of nomenclature, the earlier classifications were based on the limited available facts chiefly concerned with the host plants

Botanical readers, some perhaps less familiar with serological technique, will find these methods described as they are now utilized in virus research. Evidence shows that the viruses are themselves the antigens; for the purer the virus preparation the more active it has proved, and further, a common antigen may be obtained, for example, from plants of tobacco and phlox, infected with the virus causing tobacco mosaic. Crystalline nucleoproteins have given results of the same order, and are now regarded as the antigens specific to virus-infected plants. This is part of the experimental foundation of the author's hypothesis Serological technique has also proved of value in identification of the viruses and can be used to distinguish strains of the same virus

Since Stanley (1935) claimed to have isolated the tobacco mosaic virus, much progress has been made in the methods of purification, and the text shows those employed to obtain samples of tobacco mosaic, potato 'X', tomato bushy stunt, and tobacco necrosis viruses One yield of 80 per cent of the total protein content of the sap expressed from frozen leaves has been claimed to be virus, but in other cases cited, 2 gm. per litre of cell sap are considered to be virus From healthy plants no such compounds are obtained by similar procedure

Later chapters deal with the composition of viruses as revealed by chemical analysis—where the phosphorus and carbohydrate derived from the nucleic acid are of vital importance as without such fractions activity is greatly reduced—and with their optical and other physical properties, including crystalline structure studied by X-rays Estimates of the size of the particles and their molecular weight are included A brief account is given of the limited work that has been carried out on the physiology of virus-infected plants. The author reviews possible control measures and considers the breeding of resistant varieties to be a slow but promising line of work. Protection afforded by chance or deliberate infection with mild strains, valuable as it is with certain crops, is not considered likely to be of general use; it appears impracticable to 'vaccinate' plants against more than one virus because of the interactions and complications that may ensue.

In the concluding pages attention is focused upon the question so frequently asked by the earlier investigators · Are viruses living organisms? A straightforward definite answer cannot be given. Further knowledge regarding the activities of viruses in living tissues is needed. In the meantime it is necessary to re-examine carefully the criteria applicable to this judgment in the light of the information already known about viruses.

The book forms a readable account of recent brilliant research, the facts are authentically presented, and the literature adequately surveyed. Here and there a few trivial errors in the type have escaped the proof reader's attention; there are several short reiterations in the introductory paragraphs to the chapters. Biologists are deeply indebted to Mr. Bawden for his critical survey of the progress so recently made in this field of research.

YOUTH ON THE PROW IN CHEMISTRY

Young Chemists and Great Discoveries
By Prof. James Kendall Pp. xvi + 272 + 23 plates (London: G. Bell and Sons, Ltd., 1939.) 7s. 6d net.

IN this book of the Royal Institution Christmas Lectures of 1938–39, Prof Kendall records how "the youthful breast, inspir'd by truth's bright ray", arrived at some of the most spectacular discoveries in the history of chemistry Following Ostwald, he divides his youthful paladins into two classes · the romantic and the classical, exemplified by Davy and Faraday As one would have anticipated, his first lecture was devoted to the romantic Humphry Davy, an ideal subject for such a theme, such an audience, and such a place Then followed naturally that wonderful example of the age-old story of the master and the apprentice provided by the interwoven careers and contrasting personalities of Davy and Faraday

Davy carried out his dramatic experiments on the inhalation of nitrous oxide at the age of twenty; at twenty-two he took London by storm through his brilliant lectures at the Royal Institution; at twenty-four he was elected to the Royal Society; at twenty-eight he discovered potassium Here, then, is a perfect example of the youthful genius in chemistry.

However, like van 't Hoff, who also leaped to fame at the age of twenty-two, Davy had burnt himself out at fifty. Indeed, from Prof Kendall's examples it seems that if the romantic type be symbolized by Davy's flaming globule of potassium, the classical type may be likened to the candle, about which Faraday lectured so aptly and charmingly to his juvenile auditory at the Royal Institution Faraday's first important discovery was made when he was about thirty, and the flame of his genius shone clear and steady until he entered into the twilight of a long and fruitful life

Prof. Kendall's story, always interesting and animated, ranges from Davy and Faraday through Perkin, Couper and Kekulé, Pasteur and van 't Hoff, Arrhenius and the Braggs, Newlands and Mendeléeff, Bohr and Moseley, to the "first young heroine", Madame Curie, and ends across the Atlantic with Robert Hare, Charles Martin Hall and Irving Langmuir (who characteristically took his seat in a row labelled 'Juveniles Only' at Prof. Kendall's first lecture). The narrative thus traverses an extensive field, and Prof. Kendall's clear and easy style enables him to introduce his readers, as he introduced his juvenile auditory, to such complexities as structural formulæ, polarized light, asymmetric molecules, ionization, the classification of the elements, isotopes and radioactivity.

It is difficult to discover flaws in this entertaining story, although on one or two occasions it may be felt that Prof Kendall shows a little indulgence to his young heroes Thus, in defending Davy against those who have accused him of vanity and snobbery, Prof. Kendall quotes Dalton's statement: "The principal failing in his character is that he does not smoke" This testimonial to Davy's character becomes less impressive, however, when one refers to Dalton's original letter, which reads · "The principal failing in his character as a philosopher is that he does not smoke" Moreover, it is scarcely fair to one who has been called "the Scotch Faraday" to say that "only the mighty Faraday roused Liebig's admiration" among the chemists he met in England in 1837; for at that time, as Tilden has remarked, "Faraday having long abandoned the pursuit of pure chemistry, the most famous by far among English [that is, British] chemists was Thomas Graham", who certainly won Liebig's high approbation. "I had a very long and agreeable letter from Liebig a few days ago," wrote Graham to his sister Margaret on November 24, 1837, "conveying the information that his University have made me a Dr of Philosophy *causâ honoris*. . . . He has a grand project of publishing a chemical journal in three languages, to be edited by Liebig, Dumas, and myself."

As Prof. Kendall points out, several famous chemists have been poets, and the youthful Davy was also the subject of anonymous sonnets from fair admirers We suspect that if Prof. Kendall had not been an eminent chemist he would have achieved fame as a dramatist, if not indeed as an interpreter of the drama His lectures were rich in dramatic moments and quick changes. His book, too, ends on a dramatic note. As we are about to lay it down we discover that the "young chemist" whose classical features adorn the dust jacket is not Davy as we have hitherto supposed. To our surprise this charming illustration proves to be an early portrait of Albert Edward, Prince of Wales, afterwards King Edward VII, who in his youth received instruction in chemistry from Lyon Playfair at Edinburgh and took part there in the dramatic experiment with boiling lead which is described at the close of Prof. Kendall's

book: "the lecturer and his two gallant volunteers in turn passed their hands to and fro through the stream [of white-hot lead], and the final experiment of the 113th course of Christmas Lectures adapted to a juvenile auditory to be given at the Royal Institution was carried to a successful conclusion".

This absorbing account of youthful achievement in the realm of chemistry cannot fail to arouse and hold the interest of readers of all ages. The volume is attractively produced and copiously illustrated with plates and figures It contains references to many of the experiments and exhibits of the original lectures, and each chapter is provided with a useful bibliography The book gives rise to sundry interesting reflections. What was the spark causing the tinder of each youthful genius to burst into flame? Is there still scope in science for the youthful pioneer, in these days of intense specialization and team work? Would Faraday, with his meagre formal education and elementary knowledge of arithmetic, have been able in this exacting age to break his birth's invidious bar? These are some of the intriguing questions to which the intelligent reader must supply his own answers. JOHN READ.

GENETICS OF COTTON

The Genetics of Cotton
By Dr. Sydney Cross Harland Pp 193 (London: Jonathan Cape, Ltd, 1939) 10*s* 6*d*. net.

THE great economic importance of the world's cotton crop has led to marked advances in the genetics of cotton since 1924, when the most valuable New World species of cultivated cotton were found to be tetraploid. The researches of Dr. Harland have occupied a leading place in this development, and the present book is a fitting summary of knowledge regarding the genetics and cytology of the genus Gossypium

The first chapter, which is devoted to the taxonomy of the group, recognizes eighteen species, while ten others recognized by some authors are reduced to variety rank and two are assigned to other genera In addition, *Gossypium Robinsonii*, of Western Australia, is insufficiently known and recent efforts to find it in the wild condition have been unsuccessful Numerous specific names of cottons in the West Indies and South America are regarded as local races of *barbadense* or *purpurascens*.

The fact that four American and three Polynesian species are tetraploids with 52 chromosomes is of fundamental importance for the genetics of the cultivated cottons. The existence of five wild American diploid species, as well as other diploid species in Africa, Asia, and Australia, shows not only the great age of the genus (regarded as Cretaceous in origin) but also serves as the basis for various views regarding the origin and history of the valuable American tetraploids (Sea Island, Upland, etc.). It is evident that these form a younger section of the genus, having been derived, probably as allotetraploids, from diploid ancestors.

The cytological chapter presents the available evidence from chromosome morphology as well as number, and particularly from chromosome pairing in F_1 interspecific hybrids. Supposed constant differences in chromosome size between the Old and New World species have led to the view that the American tetraploids have resulted from chromosome doubling in sterile hybrids between species from these respective original sources. The chromosome sizes in these presumed amphidiploids do not apparently support this view, and Upcott's reinvestigation of the case of *Æsculus carnea* does not show (as is stated on p. 44) that this amphidiploid has 40 large chromosomes derived from one parent and 40 small ones from the other Nevertheless, although the evidence of chromosome size gives little support to the view that the American tetraploid species came from crosses between Asiatic and American diploids, yet the pairing in F_1 hybrids does support such a conclusion, for certain crosses between Asiatic species and New World tetraploids give thirteen pairs and thirteen single chromosomes. The evidence is not final, but the existence of tetraploids in Polynesia suggests that this condition goes back a long way in the history of the cottons.

The bulk of Dr. Harland's book is naturally devoted to the numerous results of breeding experiments. Several series of multiple allelomorphs are known, some members of which belong to different species, as in red pigmentation, leaf shape and seed fuzz. Several cases of linkage groups have been found, but with the large number of chromosomes it will be a long time before adequate chromosome maps can be constructed.

This book will be indispensable to all those concerned in cotton breeding, and to geneticists, especially for the work on interspecific modifying genes in a group of species the age of which can only be measured in geological time.

R. RUGGLES GATES.

SOME BIOLOGICAL APPLICATIONS OF NEUTRONS AND ARTIFICIAL RADIOACTIVITY*

BY DR. JOHN H. LAWRENCE,

RADIATION LABORATORY, UNIVERSITY OF CALIFORNIA, BERKELEY

THE biological and medical sciences are being stimulated and benefited by the recent discoveries of the nuclear physicist in a manner similar to that following the discovery of the naturally occurring radioactive elements and the production of X-rays. The nuclear physicist can now induce radioactivity in practically all of the elements, and he can harness a beam of neutrons of intense biological activity. This new wonderland for the biologist has been brought about by such events as the first successful experiments of Joliot and Curie in artificial radioactivity, the discovery of the neutron by Chadwick, the discovery of heavy hydrogen by Urey, and the development of the cyclotron by E. O. Lawrence and his associates.

During the past four years, workers at the University of California have been intensely interested in the biological applications of these products of the physicist, and recently a new medical-biological laboratory dedicated to this study and housing the new 220-ton cyclotron—the William H. Crocker Radiation Laboratory—has been completed in Berkeley. Because of its ability to produce large quantities of the various radio-elements and neutron rays, the cyclotron is the nucleus of this unit. The Laboratory is, however, staffed not only by physicists, but also by chemists, biologists, cytologists, bacteriologists, physicians and radiologists—all of whom are interested in both the fundamental and practical problems concerned with the interaction of radiation and matter. My purpose here is to discuss briefly some of the investigations carried on in this laboratory or in conjunction with it. Unfortunately, there is not sufficient space to discuss the extensive and important work being done in this field in other laboratories.

When Hevesy first used radium D, an isotope of lead, as a 'tracer' of lead movement in plants, the potential value of similar isotopes of elements which are important in physiological processes, such as phosphorus, sodium, iron and iodine, became apparent. These and other radioactive isotopes are now available; and, since they are chemically like their inactive relatives, their radiations simply label or tag them and enable the investigator (with the aid of a Geiger counter) to study their average exchange and distribution in biological and chemical processes, in health and disease. The effect of irradiation on the reaction is avoided by the use of sufficiently small 'tracer' amounts. On the other hand, many of these isotopes may be used as potent sources of radiation if the metabolism of the element in question is not being studied. In Table 1 are listed some of the isotopes that are used in this University. A brief discussion of studies in which these isotopes are employed follows.

TABLE 1.

Atomic number	Radio-element	Radiation	Half-life
1	Hydrogen (3)	Beta	150–170 days
6	Carbon (11)	Positron and gamma	20·5 minutes
11	Sodium (24)	Beta and gamma	14·8 hours
15	Phosphorus (32)	Beta	14·3 days
16	Sulphur (35)	Beta	88 days
17	Chlorine (34)	Positron and gamma	33 minutes
19	Potassium (42)	Beta and gamma	12·4 hours
20	Calcium (45)	Beta and gamma	180 days
26	Iron (59)	Beta and gamma	47 days
35	Bromine (82)	Beta and gamma	34 hours
53	Iodine (126)	Beta and gamma	13 days

Radioactive hydrogen is written $_1H^3$, in contrast to ordinary hydrogen ($_1H^1$) and heavy hydrogen ($_1H^2$), and has only recently been discovered by Alvarez and Cornog of this Laboratory. This newly labelled form is used in biological work and promises to become a valuable adjunct to heavy hydrogen, which has been so extensively used in 'tracer' studies. Although radio-carbon has a very short half-life (20·5 minutes), Ruben, Hassid and Kamen are successfully using it in the study of photosynthesis. Leaves of barley plants grown in an atmosphere of C^*O_2 form radioactive carbohydrates†, even when the plants are kept in darkness prior to exposure to C^*O_2. The bulk of the radioactive material found in the plant is water-soluble and does not contain carbohydrate, carbonate, keto acids or pigments. Jenny and Overstreet of the College of Agriculture grew barley in the presence of K* and showed that the intake of ions is not a uni-directional process, but that

*Based in part on a paper given before Section A (Mathematical and Physical Sciences) of the British Association, given on August 31 and September 1, 1939, at Dundee.

†The radioactive form of an element is denoted by an asterisk.

ions of the same species may move into the root and out of the root at the same time. Stout and Hoagland of the same department, using the radioactive isotopes of potassium, sodium, phosphorus, and bromine, studied their upward movement after absorption by the roots in actively growing willow and geranium plants They found that when salts are absorbed by roots, some portion enters the xylem within very short periods of time, and is carried rapidly towards the leaves under the influence of transpiration. That the content of radioactivity in the bark as compared with the root is slight indicates that movement of salts in the former is very slow

Fig 1.

THE 200-TON 60 INCH CYCLOTRON IN THE CROCKER RADIATION LABORATORY ON THE BERKELEY CAMPUS OF THE UNIVERSITY OF CALIFORNIA

Standing by the corner of the magnet and adjusting the helium flow to the target chamber is the late Dr. Harold Walke, of the University of Liverpool On the table in the foreground is an experimental deuterium generator The target chamber is behind, marked by the two port holes. Above and to the rear is seen the aluminium oscillator house or radio-frequency power supply Photograph taken by Dr. Donald Cooksey, assistant director of the Radiation Laboratory.

Mullins, of the Department of Zoology, has investigated the effect of increasing activities of radio-sodium on the penetration of Na^+ into the single-celled alga Nitella His results show that, below certain activity concentrations, there is no 'radiation' effect, and point out the importance of using low activities in 'tracer' work. Hamilton is making an extensive study of the physiology of the isotopes of sodium, potassium, iodine and other elements, in health and disease. Their rapid absorption and distribution is evidenced by their appearance in the hand a few minutes after oral administration of small amounts. The isotope of iodine is proving to be valuable in the study of thyroid physiology. Hamilton has demonstrated the marked concentration of ingested iodine in the thyroid gland and has been able to photograph the distribution of iodine by placing the excised gland on a photographic film. Anderson and her associates of the Institute of Experimental Biology have found that in adrenalectomized rats a single dose of 'tagged' sodium is rapidly lost, while potassium tends to be retained.

Radio-phosphorus (P^{32}) has been the most extensively used radioactive isotope. The ease of manufacture in the cyclotron and its relatively

long half-life (14·3 days) make it ideal for biological studies. Chaikoff and his associates in their studies of phospholipid metabolism have shown that various kinds of neoplasms in animals have individual rates of phospholipid turnover, and that cell type does not seem to be the determining factor. In association with Scott and Tuttle, the metabolism of labelled phosphorus in leukæmia in both animals and man is being investigated The finding that in leukæmic mice the phosphorus turnover is apparently proportional to the degree of leukæmic infiltration suggested the use of radiophosphorus as a source of radiation in the treatment of leukæmia in humans. The concentration of the radio-phosphorus in the areas infiltrated with leukæmic cells tends to localize the therapeutic irradiation (beta-rays). Given by mouth in the form of sodium phosphate, phosphorus is well absorbed (75 per cent) and slowly excreted (2 per cent per day) The turnover of phosphorus in red cells is rapid, whereas the white cells retain it for longer periods of time. Numerous patients suffering from chronic leukæmia are being treated with this material, and in many instances remissions in the disease are obtained.

Tarver and Schmidt, of the Department of Biochemistry, have synthesized methionine from radio-sulphur and, after feeding it to rats, have shown that the radio-sulphur may later appear as cystine extracted from the tissues. Finally, Whipple and his associates at the University of Rochester, in their studies on normal and anæmic dogs, report the following: radio-iron is poorly absorbed by normal animals; anæmic animals absorb iron in proportion to their need for it; plasma is the medium for the transport of iron; the rapid appearance of iron in the red blood cells is spectacular.

The intense beam of neutrons produced by the cyclotron has made it possible to investigate their biological effects on various objects such as bacteria, plants, Drosophila eggs, animal tumours and normal mammals. This new penetrating form of radiation has intense biological effects, even greater than X-rays or gamma rays, on normal and tumour tissue, but when compared with X-rays, selectively affects some tissues more than others. Experiments on animals indicating that neutrons are more destructive to neoplastic tissue than to normal tissue suggested their trial in cancer therapy. In association with R. S. Stone, of the Department of Roentgenology, patients suffering from cancer are now regularly being treated with neutrons from the new 60-inch medical cyclotron. The recent experiments of Kruger in this Laboratory have opened up another possible application of neutrons to cancer therapy He has demonstrated that cancers from mice placed in non-toxic concentrations of boric acid and irradiated with slow neutrons can be killed with doses of irradiation harmless to tissues not in contact with boron. The slow neutron is captured by the boron nucleus. The combination emits two heavy ionizing particles in

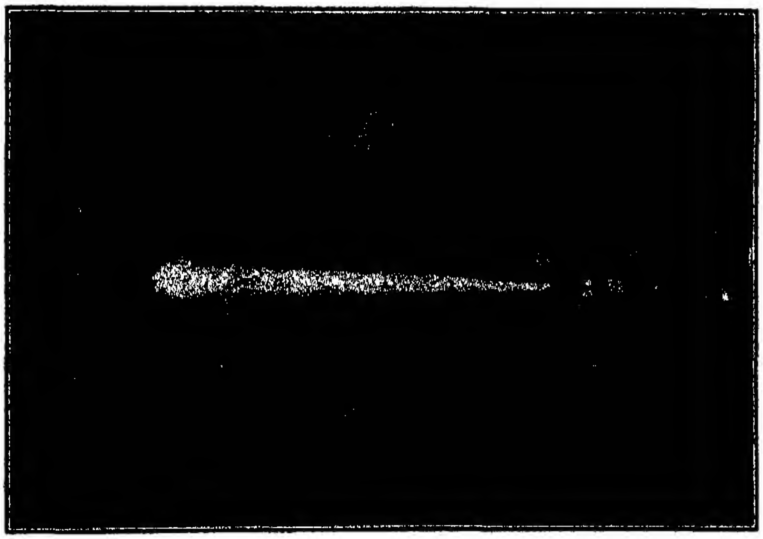

Fig. 2.

THE PATH OF A 16-MILLION ELECTRON VOLT DEUTERON BEAM TRAVERSING THE AIR FOR A DISTANCE OF NEARLY FIVE FEET.

These particles emerge from the vacuum of the target chamber with a velocity of approximately 18,000 miles per second. In slowing down over the course of their path, they give up their energy to the air molecules, causing them to glow with a violet light. However, in practice, a target to be made radioactive is placed at the emergent point of the beam and thus bombarded. Where neutrons are desired the target used is beryllium Photograph taken by Dr. Donald Cooksey, assistant director of the Radiation Laboratory.

opposite directions—an alpha particle and a lithium nucleus—which traverse a distance of about 7 μ in tissue and thus approximate an explosion within the cell.

Although the great contribution of the new nuclear physics to the problems of biology and medicine is certainly the 'labelled' or 'tagged' isotope, nevertheless it seems important to pursue the possibilities of artificial radioactivity and neutron rays in cancer therapy until a more satisfactory answer to this problem has been reached.

MOUND EXPLORATION IN THE TENNESSEE VALLEY, U.S.A.

THE operations of the Tennessee Valley Authority in the United States of America, by the erection of dams to collect and control the waters of the Tennessee River and its affluents, will inundate to a considerable depth a vast tract of land, which to the archæologist and the student of the pre- and proto-history of the indigenous peoples of America is one of the most interesting regions of the continent north of the tropics. Unfortunately, in a cultural sense it is still incompletely understood Though a great part of it, and curiously enough that especially suited to aboriginal pursuits and modes of life, was still unoccupied by surrounding tribes, possibly owing to mutual rivalries, when first visited by the white man in the sixteenth century, nevertheless the whole country abounds in evidence of prehistoric occupation in the form of mounds, shell heaps, stone implements, pottery, old fields, burial caves, and ancient cemeteries. From about 1660 onwards, these vacant lands were occupied successively by Shawnee, Chickasaw, Cherokee and Creeks, with a number of lesser tribes of uncertain affinities.

So early in the history of the Tennessee Valley Authority project as 1933, it was pointed out that the building of the dams and consequent flooding of large areas of the valley would destroy these records of prehistory for all time, unless some plan of conservation could be undertaken Already the construction of the Wilson Dam, near Florence in Alabama, by the United States Government during the War of 1914–18, had created a lake 23 square miles in area ; and to this inundation a further 100 square miles was now to be added. Accordingly, towards the close of 1933, a conference was held at Knoxville which was attended by representatives of the Authority and the Universities of Tennessee and Alabama, with Mr. Niel M. Judd of the Smithsonian Institution as consultant. As a result, archæological surveys of the areas affected were instituted and a number of excavations have been carried out with moneys provided out of Federal funds for the relief of unemployment, with the assistance of grants from universities and other learned bodies. Reports on the results of the survey work and excavation will, for the most part, be published when ready by the Smithsonian Institution of Washington.

Although the existence of a large number of mounds and other prehistoric remains in the great river-valley system, Ohio–Tennessee–Mississippi, of the United States has long been known and their character frequently described and discussed, it is only of recent years, thanks mainly to the work of Mr. Warren K. Moorhead and a small band of enthusiastic investigators, that anything approaching real understanding of the mound-culture has begun to emerge. At the moment, the focus of the problem is the distribution affinities and development of the 'Hopewell' culture, of which outstanding characters appear in what follows.

A more general characterization of the culture of these mounds, however, is given by T. M. N. Lewis, of the University of Tennessee, in a preliminary report to the American Philosophical Society on archæological investigations in the Tennessee Valley during the past five years, to the cost of which the Society had made grants from the Penrose Fund in aid of research[1].

A large quantity of documented archæological material and skeletal remains was obtained, from which the most interesting result to emerge, pending further and more detailed analysis, was the apparent linkage of the aboriginal peoples of Tennessee with those of Middle America. The large earthworks having the form of truncated pyramids, which have now been meticulously excavated, follow in cruder fashion the methods of construction of the temple pyramids of Central American lands, in which the ruins of temple buildings are found to surmount superimposed substructures. Here in Tennessee, however, the substructures are not stone-plated, as they are in the south, but are constructed of clay, whereas the superstructures, in which the religious ceremonies and business of government were carried on, were of poles, bark, cane and clay instead of stone. Elevated square or circular fireplaces constructed from puddled clay are always present in the centre of the floors. Occasionally elevated rectangular platforms and seats of hard-burned clay have been found. Changes in architectural details of the superimposed structures suggest changes in cultural occupations, which, as will be seen, are supported by analyses of the evidence. Stairways or ramps lead to the summits of the structures.

In some instances, although these structures were intended to be the town's chief ceremonial house, interments of important individuals in pits beneath the floor-levels were made. Nearly always these are lavishly accompanied by mortuary

offerings of pearl and shell beads, copper ornaments, engraved shell gorgets, and other implements and utensils of bone, stone, shell and pottery.

The villages were small, and only in rare instances could the number of inhabitants have exceeded 1,500 or 2,000 individuals. The huts were small and rude, and in close proximity one to another; the dead were buried either at haphazard throughout the village, as in the Chickamauga Dam Basin, near Chatanooga, or in cemeteries, as in central and western Tennessee.

A detailed report on key positions in the Wheeler Basin of northern Alabama which had been excavated under his direction has been made by William S. Webb, with supplements on the geology and topographic features of the region and their effect on aboriginal occupation, by Walter B. Jones, State geologist of Alabama, a study of the physical anthropology and pathology of the skeletal material by Prof. W. D. Funkhouser of the University of Kentucky, and an analysis of the ceramic material by Dr. James B. Griffin, of the University of Michigan[3].

On the general character of the relation of aboriginal occupation and geological and topographical conditions, it may be said that as a rule the principal villages or settlements with or without mounds were on level ground adjacent to rivers or lakes. Often there is an amazing amount of kitchen midden material in one or more portions of each settlement. In Tick Island, for example, refuse reaches a depth of 8 ft. for an area of nearly two acres. Other examples are the shell mounds, composed of shells, animal bones, stones, pebbles, flint chips, fashioned and broken objects, potsherds, fish remains, charcoal and occasional human burials. Mounds of this type are often so much as 200 ft. wide, 600 ft. long and 15–20 ft. high, with 60,000–100,000 cubic yards content, all left over from primitive kitchens. An archæological map prepared on the basis of material collected in a preliminary archæological survey in 1932 shows 237 sites distributed over six counties. The key sites selected for investigation numbered nineteen.

In general terms, the culture or cultures of these sites, of which the excavation is described *seriatim* in detail, may be characterized on stratigraphic evidence as a sequence. The earliest form is a pre-pottery culture, in which the bow had not come into use. Its place was filled by the *atlatl* or throwing-stick. Spear points appear in great number, associated with a broad-bladed flint knife. Apparently bodies were buried without the flesh, though the occurrence of numerous burnt bones need not necessarily denote cannibalism. Above this from a level of 6–7 ft. below the surface was evidence of a culture in which all burials were in the flesh, and with them were associated marine shells, pottery vessels, and copper. In certain instances burials were in a shell midden containing much flint and many potsherds Frequently the head was detached and alone buried. It is by no means certain that all the burials in the mounds are of the culture with which they are found.

A burial mound in Tick Island was quite in contrast with other sites in the vicinity, having a number of distinctive cultural traits, which cannot be connected with any other sites or known racial stock. Nothing but pottery, surprisingly, was used, and in quantity, for burial offerings. Some burials were flexed, some extended, but the most common practice was the burial of the detached head. All mortuary vessels were shell-tempered, while detached sherds were all gravel- or sand-tempered. The significance of this will appear later. A very unusual open bowl with much elevated strap handles and rows of protuberances has also been recorded on a number of sites along the Tennessee in north Alabama.

The association of outstanding stone artefacts with copper artefacts, particularly copper reel-shaped objects, leads to discussion of the distribution of these last. The practice of depositing these copper reel-shaped objects in burial mounds is found to centre in a comparatively small area, embracing the counties of northern Alabama. A comparison of the sites produces a very constant complex of thirty-six cultural traits, to which on account of the consistent association of copper, especially the reel-shaped objects, and galena with burials, the name of the 'copper-galena' complex has been given. The people of this culture obtained and worked native copper, buried galena with their dead, possessed many ocean shells, practised ceremonial destruction of artefacts and produced woven fabrics. They were either well on the way towards developing a specialized sedentary culture, or else they represent the degenerate form of a higher cultural complex.

In either event, although neither history nor tradition presents any suggestions for their connexion with tribes who later inhabited this territory, it is noted that they occupied the territory where de Soto (1540) reported the Yuchi to be living; while an examination of the traits here considered to be fundamental in the copper-galena complex leads to the conclusion that it may be regarded tentatively as a manifestation of the Hopewellian phase—a phase centring in the Hopewell culture of Ohio, which was the result of the high development of an able people, who over a long period of time "drew to themselves the best cultural and material wealth from a large

area, and like many a metropolis of modern times, radiated a powerful influence on customs and techniques to all less-favoured areas".

The reference to the temper of the pottery of Tick Island calls for further elucidation. In the report on pottery by Dr Griffin, it is pointed out that the distinguishing characteristic most easily definable in the analysis of the sherds from six sites submitted to him was the type of temper; it was of primary importance in recognizing and distinguishing the culturally complete ceramic types. As a rule, Dr. Griffin points out, temper is not a reliable diagnostic trait. Yet there is, for example, no evidence that the makers of the shell-tempered pottery had any cultural contact with the users of sand or fibre for tempering. Although pottery containing limestone has contacts with that containing clay or grit, such evidence is lacking for sand and fibre, although both types of pottery occur on the same site.

[1] "The American Philosophical Society. Year Book, 1938" (Philadelphia, 1939).

[2] "An Archæological Survey of Wheeler Basin on the Tennessee River in Northern Alabama". By William S. Webb. Smithsonian Institution, Washington, D.C., Bureau of American Ethnology, Bull 122, 1939

INTERGRADING AMONG PLANTS IN RELATION TO THE PROVENANCE OF FOREST TREES

By Dr. R. Melville,
Royal Botanic Gardens, Kew

It has long been known that the geographical source of the seed of forest trees is important if a well-grown and healthy plantation is to be achieved and yield a profitable return. For some years experimental plantations of European Larch have been grown by the Forestry Commission from seed of several Scottish and Continental sources Attention has been focused to an increasing degree on the question of seed provenance in an effort to obtain varieties capable of giving high yields under a variety of soil conditions in different parts of the country and able to withstand frosts and fungal diseases. With the object of stimulating interest in the question, a discussion on seed provenance and local races of forest trees had been arranged between Sections K (Botany) and K* (Forestry) of the British Association at Dundee, but did not take place before the cancellation of the meeting.

A considerable volume of research on seed provenance in forest trees has been carried out on the Continent, by far the greater part of which has been concerned with conifers, especially Scots Pine, European Larch and Norway Spruce. Much of the work has had a physiological bias The relationship of seed source to the complex of characters resulting in frost hardiness and the ripening of the shoots has been studied. Rate of growth and growth periodicity are important also and interact on the quality of the resulting timber. Among the morphological characters compared in strains of different origin are the growth habit and the form of the root system, both of which may have a profound influence on the yield under particular conditions, as well as on the form of leaves, buds and cones. It is not possible here to do more than indicate the extent of the wide field already covered by numerous experimenters, but able summaries are given by Langlet[1] and Kalela[2] The purpose of this article is to point out the relationship between some recent developments in experimental taxonomy and the question of provenance

The correlations between morphological characteristics of adult trees of different strains and their sylvicultural value so far attempted have been based in the main on the conception of species and varieties as discrete entities, varying but little and more or less easy of recognition. This is a conception related to the classical taxonomy, in which plant forms are often described from one or a few similar individuals Frequently this is unavoidable, as when the only specimens available have come from a single collecting expedition in isolated or difficult territory. Nevertheless a somewhat static view of the species as an individual results. In settled countries where extensive investigations of the flora have been made, material is available or can easily be obtained for intensive and critical studies of particular species or species groups. Such studies lead to a more dynamic view of a species as a constantly varying population in which the characters of the component individuals intergrade. To enable the foresters to make the most intelligent use of this intergrading, the taxonomist must first produce a classification in which it is embodied. The recent treatment of intergrading is a step in this direction.

Intergrading may occur within a species or between related species capable of interbreeding.

In the case of intra-specific variation, the individuals composing the species can be arranged in an orderly sequence dependent on the gradation of a particular character or group of associated characters. Huxley[3] has proposed the term *cline* for such graded series, with suitable prefixes to denote different types of cline. In connexion with the provenance of forest trees, the kind of cline likely to become of most general interest is that in which the character gradient is related to geographical distribution. For this Huxley proposed the term *geocline*, though *topocline*, as later suggested by Gregor[4], is preferable since 'geocline' suggests a cline dependent on differences of soil Also, in the future, it may be necessary to use 'geocline' in the latter sense. Huxley quoted as examples of topoclines the intergrading between the wrens of the Shetlands, Fair Isle, the Orkneys and mainland of Britain, with several more among animals, but none in plants. The occurrence of geographical character gradients, however, is probably as common among plants as animals, and little research is necessary to bring them to light. The cedars, for example, form a graded series from west to east beginning with the Atlas Cedar, *Cedrus atlantica*, of the Atlas Mountains, followed by the Cedar of Lebanon, *C. Libani* of the Lebanon Mountains and Cilician Taurus, and ending with the Deodar, *C. Deodara*, of the Western Himalaya. In geographical order the leaves increase in length from west to east, while the number of leaves in each yearly fascicle on the short shoots decreases in the same order (Fig. 1). Hooker, Henry, Dallimore and others considered these forms as varieties of one species, and at the same time retained separate specific names mainly on account of the discontinuous distribution. Continuous variation with geographical gradients probably exists in the European Black Pines, *Pinus nigra* Arnold ; the variety in the Pyrenees and Cevennes, var. *cebennensis*, has the longest and most slender needles, the Corsican Pine, var. *calabrica*, has needles of intermediate length and thickness, while the Austrian Pine, var. *austriaca*, has the shortest and stoutest needles of the western European forms. In North America the southern forms of the Shagbark Hickory, *Carya ovata*, have pubescent leaves and branchlets, while forms in the northern United States and Canada are glabrous or nearly so An examination of the available herbarium material revealed some intermediate forms from the intervening States, and it seems probable that a north to south gradient exists in degree of pubescence in this hickory.

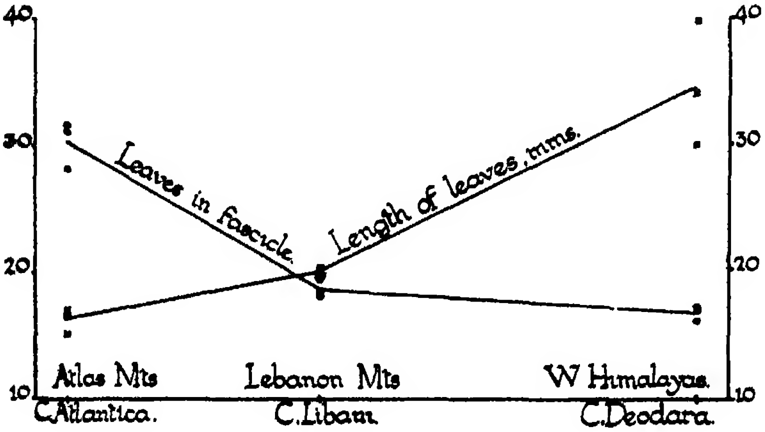

Fig 1.

TOPOCLINES IN CEDRUS. MEAN CURVES FROM THREE TREES OF EACH FORM, GROWN AT KEW, SHOWING GRADIENTS IN MEAN NUMBER OF LEAVES PER ANNUAL FASCICLE ON SHORT SHOOTS AND MEAN LENGTH OF LEAVES OF SHORT SHOOTS IN MILLIMETRES.

Lindquist[5] mentions a north to south gradient in the leaf shape of the common Wych Elm, *Ulmus glabra* Huds., which in the northern parts of its range in Europe has narrow leaves and in southern parts broad leaves Field work in Great Britain has confirmed the existence of a north to south topocline in leaf and stem characters in this elm. From Durham northwards spontaneous or subspontaneous individuals bear relatively narrow leaves (ratio of length to breadth 100 : 53–39 or less) and branchlets sparingly pubescent with long internodes. South of the Thames, the common form has relatively broad leaves (ratio of length to breadth 100 : 54–63 or more) and the branchlets are densely pubescent and have shorter internodes. Through the intervening area, forms intermediate in character occur, and there is some intermingling of broad-leaved and narrow-leaved forms as well. Owing to the frequency with which this species is planted, it is not possible to decide whether or no the intermingling of the different forms is a natural phenomenon. Occasional narrow-leaved forms are found in the south and broad-leaved forms in the north, so that it is possible that the proportions of the various forms in the population change in a regular manner from north to south in much the same way as with the bridled and normal forms of the guillemot. There is no doubt, however, of the existence of the gradient in leaf-shape with its associated characters, and a somewhat similar gradient exists in at least one other British species of elm.

Intergrading between species due to hybridization, segregation and backcrossing is well known among plants and gives rise to difficulties for the

taxonomist in such genera as Ulmus, Salix and Nothofagus The intermediate forms normally have a random distribution in the area common to both parents, but they can be arranged in graded sequences analogous to naturally occurring clines by taking advantage of a suitable character, for example, leaf shape in Ulmus For such an arrangement of hybrid forms, Melville[6] proposed the term *nothocline* and described a nothocline based on the variation of leaf shape in the numerous forms of the hybrid *U glabra* Huds × *U. Plotii* Druce. The primary need for a method of classifying hybrid swarms can thus be satisfied. The road is opened for attempts to correlate other characters, such as properties of the timber or resistance to disease, with the variable character on which the nothocline is based

The arrangement of the individuals composing a species into clines enables the taxonomist to present the data of variation in a form in which it can readily be grasped. The sylviculturist may be able to draw useful conclusions from such data. Thus it is probable that glabrous forms of the Shagbark Hickory are more hardy than pubescent forms, while some at least of the intermediate-leaved forms of the Black Pine are the most desirable sylviculturally. If it proves feasible for the taxonomist to define ecoclines—a gradient related to conditions of the habitat—in woody species, some help may be afforded in the choice of the most suitable form for a particular site. A study of the European Larch on these lines would be useful. Until further work has been done on hybrids, the value of the nothocline remains problematical, though it seems probable that when linkage exists between morphological and sylvicultural characters, it will be revealed by the groupings arrived at in this type of classification. If this proves to be the case, the taxonomist may be able to indicate the best forms for propagation from the numerous wild forms in such hybrid swarms as those connecting the elms, *Ulmus glabra* and *U. Plotii*, and the common pedunculate and sessile oaks, *Quercus Robur* and *Q. petraea*

[1] Langlet, O., *Svensk. Skogs foren. Tidsk*, 1-2 (1938).
[2] Kalela, A, *Comm. Inst. Forest. Fenn.*, **26**, 1-445 (1938).
[3] Huxley, J., NATURE, **142**, 219 (1938)
[4] Gregor, J. W, *New Phytol.*, **38**, 321 (1939)
[5] Lindquist, B., *Acta Phytogeog. Suecica*, **4** (1932)
[6] Melville, R, *Proc Linn Soc*, **151**, 157 (1939)

OBITUARIES

Prof. C. Białobrzeski

PROF. CZESŁAW BIAŁOBRZESKI, who was recently executed by the German authorities in Poland, came from a family of Polish country squires, settled in the Ukraine. He was born in 1879, when the Ukraine was a province of the Russian Empire. His earlier scientific and academic career was spent in the University of Kiev. Like other selected candidates for professorships he was sent abroad to continue his training Langevin was the man to whom he chose to be attached. To Białobrzeski, he was the embodiment of the ideal physicist, the man uniting philosophical clarity and vigorous theoretical penetration with fine understanding of experimental work. Białobrzeski was all his life a faithful admirer of Langevin, in spite of a fundamental difference of views in everything but physics.

At Kiev, Białobrzeski held his first two appointments, as *Privat-docent* and assistant professor. After Smoluchowski's premature death, the University of Cracow chose Białobrzeski to be his successor. It was, however, not until a year or two after the end of the Polish-Bolshevik War that many Poles living in Soviet Russia were allowed to leave for Poland. Białobrzeski was among those repatriated. He was appointed professor at the University of Cracow; but a year later he answered the call to the capital. He settled in Warsaw, as professor of theoretical physics in the University, a position which he held until his death.

Theoretical physicist though he was by virtue of his appointment, he could never face being severed from a general physical laboratory. After some struggles, he had a laboratory of his own, well equipped and staffed with talented young people. The work of this laboratory is well known to every specialist in spectrography or dielectrics.

Białobrzeski published few papers. The subjects treated in his papers during his professorship in Warsaw were stellar radiation, absorption and diffusion of light, and dielectrics. His last papers were on cosmic ray bursts and on ionization in liquid dielectrics.

Białobrzeski was a very active member of the International Institute of Intellectual Co-operation, an organ of the League of Nations. Owing to his efforts, and undoubtedly to the keen interest he took in philosophical problems, about thirty leading theoretical physicists from Europe and America were invited to Warsaw by the Institute of Intellectual Co-operation for the purpose of discussing the philosophy of physics. This meeting took place on May 29–June 2, 1938, under the presidency of Prof. Białobrzeski.

He was a member of the Polish Academy of Sciences and several times president of the Polish Physical Society.

M. MATHISSON.

Dr. H. J. Walke

Dr. Harold Walke died in Liverpool on December 21 from the effects of an electrical shock received while working in the Physics Laboratory of the University. He was twenty-eight years of age.

Dr. Walke was educated at the Plymouth Corporation Grammar School and University College, Exeter. He early developed an interest in the growing subject of nuclear physics, and he published in quick succession a number of papers and notes which, while perhaps speculative and uncritical, revealed a fertile mind and a very fresh enthusiasm. In 1935 he was awarded a Commonwealth Fund fellowship and this gave him his first opportunity for experimental work in nuclear physics. He proceeded to the Radiation Laboratory, Berkeley, where he worked for two years under the direction of Prof. E. O. Lawrence [Dr. Walke appears in the illustration of one of the Berkeley cyclotrons on p. 126 of this issue.] He published a number of excellent papers on artificial radioactivity produced in elements from potassium to vanadium.

Walke returned to Great Britain in 1937 to work in the Physics Laboratory, Liverpool, and in 1938 he was awarded an 1851 Exhibition senior studentship. He helped in the construction and operation of the cyclotron and, in addition, he continued his investigations into the activities induced in scandium, titanium and neighbouring elements, making some interesting discoveries in connexion with nuclear isomers and with the process of electron capture. He spent the summer of 1939 in Berkeley and returned in December with much work in hand and full of plans for the future. He had before him a career rich in promise, and his death at so early an age is a great loss to physics. Friendly and unassuming in manner, yet full of a vigorous and burning enthusiasm for his work, Walke was a delightful colleague. He is mourned by many friends both here and in the United States.

Mr. Douglas H. Baird, C.B.E.

Douglas Heriot Baird, managing director of Messrs. Baird and Tatlock (London), Ltd., died on January 3, at fifty-six years of age. The direction of such a business implies a wide knowledge of laboratory practice and of scientific progress. Mr. Baird was well endowed in these respects by virtue of education at Charterhouse, University of London and Karlsruhe (under Engler), and also by twenty-seven years' experience in the business, nineteen in succession to his father, the late Mr. Hugh Harper Baird, who founded it in 1879.

The business being world-wide, Mr. Baird travelled extensively—Canada, the United States, India, Ceylon, Burma, etc.—believing that requirements peculiar to overseas trade can only be properly satisfied by an intimate acquaintance with the local conditions. In these countries, and in those of Europe, Mr. Baird had many friends, and it is safe to say that he met at one time or the other almost every well-known director of a laboratory. During the War of 1914–18, Mr. Baird, besides running a poison gas filling factory, did important work in connexion with field laboratories. He designed the first mobile bacteriological laboratory sent out to France, and was responsible for the improvements in this, and the planning of other special laboratories for the use of the Army Medical Service of the Allies. He was created a Commander of the Order of the British Empire for his services.

After the War, Messrs. Baird and Tatlock became associated with Messrs. Hopkin and Williams, Ltd. A complete new series of the well-known catalogues were issued and the works at Walthamstow were rebuilt. During the past year a six-story annex to their warehouses in Cross Street, Hatton Garden, E.C. has been erected. One floor of the new building is occupied by laboratories of the company's own design and construction.

The work carried out in these laboratories comprises the testing of apparatus, chemicals and materials for laboratory construction; preparation of standard solutions, microscopic stains, indicators, and special reagents; research in chemical manufacturing methods; and the preparation of some of the rarer chemicals (chiefly organic). Special attention is being devoted to the last-named section, which has already turned out a large number of new products, some of which have not previously been obtainable in Great Britain.

Last year a new branch of the firm was opened in Calcutta to deal with increasing trade in the East, and in England the Hopkin and Williams' chemical side has been developed by building two research laboratories in Cross Street, and one semi-industrial research laboratory which is a liaison between the investigating laboratory and the work for elaboration of new processes.

Mr. Baird was chairman of the British Chemical Ware Manufacturers' Association, this year being his twelfth in office, and a member of the Standards Committee of the Institute of Chemistry, and of a number of other bodies associated with scientific affairs and apparatus.

We regret to announce the following deaths:

Mr. J. E. Dowson, known for his work in connexion with producer gas, on January 3, aged ninety-five years.

Prof. L. Hopf, professor of applied mathematics in the University of Aachen until 1933, on December 21.

M. Max Laubeuf, member of the Section of the *Applications of Science to Industry of the Paris* Academy of Sciences, a pioneer in the development of the modern submarine, aged seventy-five years.

Mr. Reginald A. Smith, keeper of the Department of British and Medieval Antiquities in the British Museum during 1927–38 and director of the Society of Antiquaries, on January 18, aged sixty-six years.

NEWS AND VIEWS

Dr. C. H. Desch, F.R.S.

PERHAPS the outstanding characteristic of Dr. C. H. Desch, who retired from the post of superintendent of the Metallurgical Department of the National Physical Laboratory at the end of last year, was the astonishing—possibly unique—breadth and depth of his scientific knowledge and interests. Educated at the Finsbury Technical College, the University of Wurzburg and University College, London, as a chemist, he entered the Metallurgical Department of the last institution in 1902. From 1909 until 1920 he was at the University and Royal Technical College, Glasgow. In 1920 he was elected to the chair of metallurgy in the University of Sheffield, a post which he held until 1931. Thus from 1902 until 1931 he was almost continuously engaged in metallurgical teaching and research

Although primarily a metallographer, Dr. Desch's knowledge of the more practical aspects of metallurgy is wide, and his contributions to discussions are invariably welcomed by those engaged in industry. Alongside his metallurgical work, however, Dr. Desch has retained his interests in every branch of chemical advance; but the chemistry of cements and concrete, the intermetallic compounds, and the crystalline state in general have claimed his chief attention. The respect in which his scientific abilities have been held may be gauged by the variety of offices which he has filled. From 1926 until 1928 he was president of the Faraday Society; during the winter of 1931–32 George Fisher Baker lecturer in the University of Cornell, while at present he is president of the Institute of Metals and vice-president of the Iron and Steel Institute. Dr. Desch is now scientific adviser to the Iron and Steel Research Council

Dr. C. Sykes

As chemistry was the avenue which led Dr. Desch into the field of metallurgy, so, in the case of Dr. C. Sykes, his successor as superintendent of the Metallurgical Department of the National Physical Laboratory, has physics functioned. After graduating in science in the University of Sheffield in 1925, Dr. Sykes spent one year carrying out research in physics under Prof. R. S. Milner. After obtaining the degree of M.Sc. in 1926, he entered the Metallurgical Department under Prof. Desch as a Metropolitan-Vickers research scholar. Two papers on the alloys of zirconium published in the *Journal of the Institute of Metals* in 1928 and 1929 appear to represent the first fruits of his work as a metallographer.

Since 1928, Dr. Sykes has been connected with the research organization of Messrs. Metropolitan-Vickers Electrical Co., Ltd., being engaged at first on work on high vacua, thermionic valves and X-ray tubes. About 1934, under the influence of Prof. W. L. Bragg, he began to publish in the *Proceedings of the Royal Society* and the *Journal of the Iron and Steel Institute*, and later in the *Proceedings of the Physical Society* and the *Journal of the Institute of Metals*, a remarkable series of papers on the super-lattice, the order-disorder change in β-brass and other alloys, on the supposed low-temperature critical points in iron and steel and on age-hardening. Some sixteen papers, all of real importance, represent the contribution which Dr. Sykes has made in little more than five years to that field of knowledge which is concerned with the physics of the metallic state.

Baron Richerand (1779–1840)

BARON BALTHASAR ANTHELME RICHERAND, a famous French surgeon, was born at Belley in the Ain Departement on February 4, 1779. He studied medicine in Paris, where he qualified in 1799 with a thesis on fractures of the neck of the femur, and two years later published his "Nouveaux Élémens de Physiologie", which met with a remarkable success and went through thirteen editions and was translated into seventeen foreign languages. In 1802 he was appointed assistant surgeon to the Hôpital Saint-Louis, where he later became surgeon-in-chief. In 1805 appeared his "Nosographie et Thérapeutique chirurgicales" in three volumes, of which the sixth edition was published in 1821. In 1807 he was made professor of surgical pathology in the Paris medical faculty, where he continued to lecture for more than thirty years.

In acknowledgment of the care which he had bestowed on the Russian and German wounded in 1814 in the Hôpital Saint-Louis, which had become converted into a huge ambulance, Richerand was made Commander of St. Anne and Knight of St. Wladimir by the Emperor of Russia and received the Military Order of Frederick from the Grand Duke of Baden and a gold medal from the King of Prussia. In 1824 he was appointed surgeon to Louis XVIII and in 1829 hereditary baron for his services to science and humanity. His minor works included "Des erreurs populaires relatives à la médecine" (1810) and "Histoire des progrès récents de la chirurgie" (1825). He also wrote notices of Bordeu, Cabanis, Brillat-Savarin, Ambroise Paré, etc., and a large number of articles in the "Dictionnaire des sciences médicales", *Mémoires de la société d'émulation*, *Bulletin de la Société philomathique*, *etc.* He died on January 23, 1840. A posthumous honour was paid to him in 1851 when the Avenue Saint-Louis was renamed after him.

Utilization of Scientific Research during War

IN the House of Lords on January 18, Lord Strabolgi asked the Government questions on the methods being adopted to examine 'war inventions',

(*Continued on page* 143)

NATURE

SUPPLEMENT

Vol. 145 SATURDAY, JANUARY 27, 1940 No. 3665

SHORT REVIEWS

Biology

The General Aspects of the Vegetation of Europe
By Marietta Pallis. Pp. iv+66. (London: Taylor and Francis, Ltd., 1939.) 3*s*. 6*d*. net.

IN this essay, Miss Pallis endeavours to assess the various factors which have determined the character of the existing vegetation of Europe. She naturally places in the foreground the climatic factors, particularly the rainfall, which according to Schimper governs the development of woodland and grassland respectively. For Europe, with its comparatively abundant rainfall, woodland should be dominant. But this dominant vegetation which Miss Pallis calls primitive has been considerably modified by the action of animals and man, both in historic and in prehistoric times. Miss Pallis thinks that Schimper did not appreciate sufficiently the enormous effect of such action, to which he only refers incidentally. The fact that much of the present vegetation of Europe is of a secondary or degenerate type caused by animal and human interference seems to the author to be of far-reaching importance.

Farrow's experiments on the vegetation of the Breckland have demonstrated the modifying effect of rabbits, and Miss Pallis in her essay directs attention to many other instances of the change in vegetation produced by man and domestic animals, particularly goats, in other parts of Europe—Thessaly and Greece being especially chosen as examples.

But apart from what is going on at present, Miss Pallis indicates that such changes may have been occurring for an indefinite length of time, long before human interference occurred. The disappearance of the forest covering the greater part of Europe began gradually, she believes, with the appearance of herbivorous animals and gained in speed towards the end of the Tertiary period, when the grazing horse took the place of the browsing horse. The appearance of these horses coincides with the progressively falling percentages given by Mrs. Reid and Miss Chandler for the woody plants of the Tertiary.

In a table at the end of the publication, Miss Pallis sets out clearly some of the facts on which she bases her conclusions. Her essay, in which a great many facts have been gathered together, both from her own observations and from those of others, gives much food for reflection, and should be carefully studied by all ecologists and plant geographers

Wild Chorus
Written and illustrated by Peter Scott. Pp. x+120+68 plates. (London: *Country Life*, Ltd., 1939.) 21*s*. net

THE pictures take the stage in this attractive book, and the text makes an appropriate background. The writing is simple and direct, and whether the author takes us after geese in the mud-flats of the East Anglian coast, on the plains of Hortobagy, on the Black Sea or in Persia, or merely describes the return of Annabel or Barnacle Bill, or the punting risks encountered at the railway bridge, he manages always to convey a sense of adventure and a feeling of enthusiasm in his exploits.

Few artists have been able to catch the attitudes and colour patterns of birds without losing spontaneity by paying too great attention to feathers, but Peter Scott has this gift. He is too familiar with his ducks and geese to miss their particularities, and his fine appreciation of design and of the effect of masses of light and shade are strikingly shown in such pictures as "Pink feet paired", "Blue Sky and Snow Geese", and "Four Teal". The colouring varies considerably in quality: among the most successful are "La Toilette", a picture of two pink-footed geese upon wet sand, "Garganeys in Spring", and the subdued yellows and greys of "Geese moving from Stubble to Potatoes". But in some, while the action and grouping of the birds themselves are beyond criticism, the treatment of clouds and water is harsh

and the colours strong even to hardness. There are two fine sepia reproductions of water-colour drawings, flamingoes and Caspian pelicans, and the quality is so delicate that one could have wished that a coloured plate had been spared for a water-colour.

An odd mis-spacing occurs in the legend of the plate facing p. 10, "BRENT GEESE COMING OFF THE ZO STERA", which suggests an exotic lake rather than a common water-weed.

To anyone who delights in lively narrative and in the colouring, action and groupings of geese and ducks in the air or on water or land, this work will afford great pleasure. JAMES RITCHIE.

A Book of Roses

By J. Ramsbottom. (The King Penguin Books.) Pp. 30+16 plates. (Harmondsworth: Penguin Books, Ltd., 1939.) 1s net.

THIS charming little book reproduces most excellently in octavo size sixteen coloured plates by that master of botanical portraiture Pierre Joseph Redouté, whose magnificent three-volume work "Les Roses" was published in thirty parts between 1817 and 1824. In addition to the exquisite reproductions, there is for each of the roses figured a short account giving botanical and horticultural information.

Of Redouté himself there is a good account. His career is full of interest. Shortly before the French revolution he came over to England to learn the English methods of stipple engraving not then used in France.

The major part of the text of the "Book of Roses" is devoted to the history of this queen of flowers. The earliest known European representation of the rose is found in the House of Frescoes at Knossos, dating from the middle of the sixteenth century B.C. The ancient coins of Rhodes had figures of roses, which flower gave the name to the island. Herodotus and Theophrastus, the father of botany, both give accounts of the rose. From these early representations and descriptions of the rose through Roman and medieval times to the present day, Dr. Ramsbottom follows up carefully and delightfully the history of the rose. His very readable and informing text seems to refute a passage of Walter de la Mare:

> . . . . . . "No man knows
> Through what wild centuries
> Roves back the rose".

The "Book of Roses" is sure of a warm welcome, and the publishers are to be congratulated on their production of this most charming little book.

The World of Plant Life

By Prof. Clarence J. Hylander. Pp. xxii+722. (New York: The Macmillan Company, 1939.) 32s. 6d. net.

PROF. HYLANDER, in his preface to this volume, says that it was "planned and written with the specific purpose of making the layman familiar with a few of the interesting plants, both native and introduced, which are found in the United States". He has purposely avoided using unnecessary technical terms, and has written throughout in a style that will appeal to the non-scientific reader. Indeed, in some instances he is perhaps too lax in his statements, as when he says in his preface that "Gardening is a fundamental instinct", a view that few psychologists would support!

After an introductory section on the whole plant kingdom, Prof. Hylander works step by step through the various groups, commencing with bacteria, and following more or less the system of Engler. As end-papers there are phylogenetic 'trees' showing the supposed lines of plant descent from fission plants to palms and pinks. It is perhaps a pity to include these in a popular work, as many readers will assume that such trees rest on a firmer foundation than is actually the case. This is especially so if Engler's system is used, as Engler himself was definitely sceptical regarding its phylogenetic basis.

Under each family Prof. Hylander mentions a number of genera and species of special interest to American readers, and the information he gives will undoubtedly provide a useful scientific background for the study of American vegetation, both native and introduced.

The illustrations are excellent, and special mention should be made of the attractive silhouettes at the head of each part.

Looking at Life

An Introduction to Biology. By A. M. S. Clark and G. Buckland Smith. Pp. xvi+224. (London: J. M. Dent and Sons, Ltd., 1939.) 2s. 6d.

THE cinema has now come to be regarded as a valuable tool in the construction of a biological education. The visual images that the viewer carries away with him are necessarily more stimulating and dynamic than the static photographs of text-books. But the transitory character of a film-showing has a disadvantage in that if a mistake in visual memory is made by a pupil it may well persist, so that the aim of the authors of "Looking at Life" in supplying an elementary book which could be used as a complement to the already available biological films is admirable.

Unfortunately, the text of the book contains little more than a potted version of the more rigid university botany and zoology courses and is scarcely suitable to serve as a first course in biology. Animal and plant types are described in a manner completely unrelated to any local environmental conditions, so that a syllabus based on this book would be, at least with regard to the animals, almost entirely theoretical, or would have to rely largely upon museum specimens. Better use of already existing films would have been made if the framework had been constructed around representative types of freshwater and terrestrial forms which are likely to be available. The text itself is a strange mixture of clarity and obscurantism, while the complete omission of gymnosperms is peculiar in a book where all the other main plant phyla are described.

Chemistry

Electrochemistry and Electrochemical Analysis

A Theoretical and Practical Treatise for Students and Analysts. By Dr. Henry J. S. Sand. Vol. 1: Electrochemical Theory. Pp. viii + 134. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 4*s.* 6*d.* net.

THE preface states that this, the first of two volumes, deals with general principles, the second volume being planned to be a guide to modern methods of gravimetric electroanalysis. The present volume provides a clear and sound introduction to electrochemistry and covers all the theoretical matters which will arise in the practical part, some of which are not very well explained in other books. The section on transport numbers is good and the concentration changes at electrodes dealt with in Chapter vii are clearly explained The modern theory of electrolytes is briefly yet adequately dealt with, but it is unfortunate that both the equations given on p. 64 are incorrectly printed. Some expressions are peculiar; for example, on p. 57 the 'valency of a reaction' is mentioned, and the system of numbering of the equations is sometimes rather puzzling. The book will be particularly useful to analysts who have to use the electroanalytical methods and have not kept up to date in electrochemical theory, whilst all students will welcome the concise and clear way in which the principles of the subject are discussed.

Aids to Organic Chemistry

By Stanley F. Smith. (Students' Aids Series.) Second edition. Pp. viii + 120. (London: Baillière, Tindall and Cox, 1939.) 3*s.* 6*d.*

THE second edition of this useful little work has been revised, the sections on sugars and complex aromatic compounds have been re-written to bring them up to date and give the modern ideas on their structural formulæ, and the index has been enlarged. The author, however, has been careful not to expand the text so as to change the character of the book. The volume provides a concise summary of organic chemistry which will be very useful to medical students in the preparation and revision of the subject, and it is a useful supplement to text-books which deal with the topics in more detail.

The Economics of Chemical Industries

By Dr. Edward H. Hempel. Pp. ix + 259. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 16*s.* net.

IT is regarded at least as important to be able to sell an article as to make it; indeed the salesmen are more highly remunerated than the technical workers. Whilst personality is the greatest asset for a salesman, there is growing up a science of salesmanship and management which is evidenced by the increasing number of books dealing with various aspects of the subject.

This particular one seeks to portray the characteristic background and the economics common to the American chemical industries. It is very informative and will be of great value in its country of origin and of interest elsewhere to firms which have business connexions with the American chemical industry. It deals largely with legislation, foreign chemical trade, and financial policies, and contains a considerable amount of statistical matter. A similar volume based on British customs would have wide appeal.

Engineering

(1) Lehrbuch der Hochfrequenztechnik

Von Dr. Fritz Vilbig. Zweite verbesserte und erweiterte Auflage. Pp. xxviii + 1019. 35.80 gold marks.

(2) Schrifttumsverzeichnis zum Lehrbuch der Hochfrequenztechnik

Von Dr. Fritz Vilbig. Zweite verbesserte und erweiterte Auflage. Pp iv + 172. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 8 gold marks.

THE publication of Dr. F. Vilbig's monumental text-book on high-frequency phenomena two years ago provoked expressions of general and well-merited approval, for it was clear that its author had successfully attempted the difficult task of surveying, in up-to-date fashion, a field already extensive. and yet expanding. In particular was his effort commended for the judicious balance of his selection of material, old and new Two years is a long time in wireless history, so that it is not at all surprising that Dr. Vilbig has already been obliged to undertake the preparation of a second edition (1) of his book. The changes made are naturally mainly by way of additions, the chapters being expanded on the average by a fifty per cent increase of text, though naturally the expansion is relatively greater in the case of such swiftly developing subjects as the study of wave propagation and television. An entirely new chapter on modern acoustics has, however, been added at the end of the book.

In Dr. Vilbig's first edition a most comprehensive and up-to-date bibliography of books and original papers occupied no less than a hundred pages. In view of the expansion of the main text in the second edition, it has become necessary to publish this bibliography as a separate volume (2), which is, of course, correspondingly enlarged and brought up to date.

Radio Interference Suppression

By G. W. Ingram. Pp. viii + 154. (London: The *Electrical Review*, Ltd., 1939.) 5*s.* net.

IT is not often that one branch of applied science reacts so unfavourably on another branch, and the difficulties which have arisen from the interference from power circuits and apparatus in the prevailing types of radio-receivers were scarcely anticipated. The problem assumed international magnitude, and has only within the last few years been brought down to a qualitative basis. Meanwhile the British Post Office has been investigating and advising on tens of thousands of cases per annum, and it is to them that we owe the idea that

the interfering radio currents travel along power and other mains longitudinally, that is, along the wires in parallel; indeed, the impedance to earth of such mains may be megohms, thus conserving the disturbing energy. The variegated field has now been sorted, and a very complete guide offered by the present author, whose firm has been in the forefront, both in theory and practice, of interference suppression In principle the methods are simple, the application of condensers to earth, with or without appropriate chokes, being most general, the economic design of units and their proper location, however, requires systematic thought Much of the author's information is usefully tabulated L. E. C. H.

Applied Acoustics
By Dr. Harry F Olson and Frank Massa Second edition Pp. xviii + 494 (London: Constable and Co, Ltd, 1939) 25*s*. net

AMONG the most important applications of science in commercial engineering is sound-films, and the Radio Corporation of America, which has the services of the authors in high executive capacity, has always shown initiative and independence of the Western Electric, its major competitor, in improving sound recording and reproduction both as a whole and on the scale demanded by cinema-goers The new edition is a somewhat expanded version of the first edition, with the necessary sections brought up to date. The text is most readable and remains the best summary of technical applications of what was long considered to be an academic scientific subject. The side-issues are many, including the measurement of noise, the control of transmission of sound vibrations through building structure, much physiological acoustics, and sound-signalling The print and diagrams are both excellent. L. E. C. H.

Geology

Outlines of Historical Geology
By Prof. Charles Schuchert and Prof. Carl O Dunbar Third edition, entirely rewritten Pp v+241 (New York: John Wiley and Sons, Inc.; London Chapman and Hall, Ltd, 1937.) 12*s*. 6*d*. net.

THIS book provides a summary of geological history; but it must be stated at once that this history has special reference to North America, since mention—and that brief—is made of only a few non-American topics or examples. It is not intended for the specialist, its aim being to provide a short general survey of earth-history As the authors say, their intention is to bring into relief the high lights of this history, and this they certainly succeed in doing.

The story is presented in four parts, the first dealing with the nature of the evidence, the second with the physical history and the third with the history of life. The sections concerned with the later episodes of geological history have deliberately been made fuller than usual in a book of this size, this added detail leading up to the fourth part of the book, in which man's geological history is considered. The account of the evolution of mammals, including man, is especially well done. As usual in American text-books, the illustrations are abundant and mostly excellent; a few mistakes have been noted—for example, there are no Tertiary lavas in the Orkneys.

This is an excellent book for a geology student desiring a summary of North American historical geology, or for the general reader in search of a refreshing but authoritative account of the marvellous pageant of life revealed by palæontology.

Geology for Engineers
By Brig.-General R. F. Sorsbie. New edition. Pp. xxii + 348. (London: G. Bell and Sons, Ltd, 1938.) 12*s* 6*d*. net.

THE first edition of this book was published in 1911, and while the same general arrangement is retained in the new volume, the former chapters on historical geology have been omitted and the section on applied geology extended, so that it now forms nearly two-thirds of the book. No new illustrations are used, all the diagrams being taken from the old edition. Much material is quoted direct from other authors, and modern treatment of subjects such as clays and soils is lacking The bibliographies which are given with various chapters would be improved by the inclusion of fuller details and dates; the titles of works published more than sixty years ago could well be replaced by those of more recent text-books

Mathematics

Elliptic and Hyper-elliptic Integrals and Allied Theory
By the late W. R. Westropp Roberts. Pp. viii+311. (Cambridge: At the University Press, 1938.) 12*s*. 6*d*. net.

WILLIAM RALPH WESTROPP ROBERTS was the eldest son of the senior fellow of Trinity College, Dublin, and after a brilliant career as a student in which he gained most of the important prizes in the Mathematical School, he was elected to a fellowship at his father's college in 1882. During the remainder of his life he made many noteworthy contributions to mathematics and in later years planned to publish a work embodying his researches. The present volume is the outcome of that aim, but unfortunately, the author did not live to complete his work.

The text is divided into six chapters, the first of which is devoted to some necessary theorems in algebra. Then follows a lucid discussion of some elementary integrals upon which the more general integral is shown to depend. In this chapter, a very interesting and valuable analysis is given of the function $R(z, n) \equiv d\chi/dz - d\chi/dn$, where χ denotes $A_0\{f(z) - f(n)\}/(z - n)$, which is essential to the development of the subsequent theory. Chapter iii is devoted to algebraic equivalents and Abelian transcendents. The text then passes to Abelian or hyper-elliptic integrals, in which there is a clear

investigation of their periodicity. Finally, Chapters v and vi are concerned with the particular cases in which $m = 2$, giving rise to elliptic integrals and functions, and $m = 3$ of the general polynomial $f(z)$ which occurs under the square root in the denominator of the integrand. Each chapter closes with a set of examples for the student's use, and among these may be found some important theorems

It is evident that the work is not complete as there are several references to Chapter vii and the figures contained therein, but this chapter was never written nor were the diagrams drawn. In spite of this, however, the book is not only a striking essay in mathematical analysis, but is also a notable contribution to the subject F G W. B

Étude critique de la notion de collectif

Par Prof Jean Ville. (Monographies des probabilités, Fascicule 3.) Pp. iv+144. (Paris: Gauthier-Villars, 1939.) 75 francs.

THERE are many ways, none altogether satisfactory, of defining probability, but roughly speaking, these fall in two groups, namely, those based upon the 'equally-likely' concept of Laplace, and those based on the concept of frequency In recent years the frequency method has been greatly developed by von Mises, who introduced the notion of a *collective*. This is defined as a mass phenomenon or an unlimited sequence of observations such that the relative frequency of a particular attribute tends to a fixed limit unaffected by any place selection or gambling system. The probability of the attribute in the given collective is then defined as this limit. It is claimed that this treatment avoids the logical difficulties inherent in Laplace's method.

M. Ville makes a careful analysis of the ideas of von Mises, and also of those of Reichenbach, Popper, Copeland and Wald, who have put forward closely related theories. The conclusion is that the idea of a collective, though roughly what is needed, is too rigid. In particular the use of the word limit, in the strict mathematical sense, either leads to results which are inconsistent with themselves, or at best necessitates a set of artificial restrictions which are really alien to the nature of the problem. A satisfactory definition of probability has not yet been found. H T H. P

Orthogonal Polynomials

By Prof. Gabor Szegö. (American Mathematical Society, Colloquium Publications, Vol. 23.) Pp. ix+401. (New York: American Mathematical Society, 1939.) 6 dollars.

ORTHOGONAL polynomials were first studied in connexion with a certain type of continued fractions, bearing the name of Stieltjes. They are closely related to problems of interpolation and mechanical integration, and recently have come into prominence in connexion with mathematical statistics and quantum mechanics. They are also connected with trigonometric, hypergeometric, Bessel, and elliptic functions, and occasionally occur in the theories of differential and integral equations. The present book is the first in the English language on the subject, and indeed the first extensive treatment of the subject in any language. It deals both with special orthogonal polynomials, such as those of Jacobi, Laguerre, and Hermite, and also with the general theory. In particular, there is an account of recent investigations of the distributions of the zeros, of asymptotic representations, of expansion problems, and of certain questions of interpolation and mechanical integration Some of the results not previously published are due to the author himself. The book concludes with a set of sixty problems, a bibliography, and an index H T H. P.

Mathematical Tables

Vol. 7: The Probability Integral By W F Sheppard Completed and edited by the Committee for the Calculation of Mathematical Tables. (Published for the British Association for the Advancement of Science) Pp xi+34. (London: Cambridge University Press, 1939.) 8s. 6d. net.

THESE tables are concerned with the values, from $x = 0$ to $x = 10$, of the functions

$$F(x) = \frac{1}{\sqrt{(2\pi)}}\int_x^{\infty}\exp(-\tfrac{1}{2}t^2)dt,\ z_x = \frac{1}{\sqrt{(2\pi)}}\exp(-\tfrac{1}{2}x^2).$$

Tables I and II give the ratio $F(x)$ z_x at intervals 0·01 and 0·1 for x and to 12 and 24 decimal places respectively

The remaining four tables give natural and common logarithms of $F(x)$. Interpolation is facilitated by the tabulation of derivatives or differences.

The Committee's amplification of Sheppard's work consisted in the completion of Table I and the computation of Table VI.

"The Committee believe that the completion and publication of his tables of the probability integral constitute just that memorial to Sheppard's unsurpassed labours in the field of Mathematical Statistics, which he would himself most greatly have appreciated."

METEOROLOGY

The Drama of Weather

By Sir Napier Shaw. Second edition. Pp xiv+307. (Cambridge: At the University Press, 1939.) 10s. 6d. net

IT is evidence of the growing interest in meteorology that this book should within five years have been reprinted and have now reached a second edition, enlarged by the addition of two chapters with the titles "Where our Rain Comes From" and "Chapter and Verse for Weather in Relation to Agriculture".

The added chapters carry on the happy traditions of the previous portion, the fresh and picturesque language, the concrete as opposed to the abstract statement, and the use of ingenious diagrams containing data that other writers have not attempted to embody. Such diagrams bring into prominence facts which might remain unnoticed if their discovery depended on a severe study of columns of figures; for example, Fig. 93 (p. 258) reveals at

once that in the British Isles places fully exposed to the west winds have much heavier rain in winter than in summer, while on the east coast rainfall is more evenly distributed through the year. The author loves a paradox and a note of interrogation regarding widely prevalent ideas. In the first of the new chapters he is certainly successful in stimulating thought when he defends the idea that the pressure distribution is produced by the winds, not vice versa.

The chapter on agriculture contains a number of interesting diagrams It includes a discussion of the calendar, though it makes no mention of the widely supported World Calendar in which the year consists of four quarters each of three months or 91 days, beginning on a Sunday; in it the 365th day is inserted between December and January.

The book is strongly recommended, to meteorological specialists and laymen alike, for its wide range of appeal, historical and artistic as well as scientific. G. T. W.

Meteorology for Aviators

By Dr. R. C. Sutcliffe. (Air Ministry: Meteorological Office) (M.O. 432: A.P. 1699) Pp. xiv + 278 + 27 plates (London H.M. Stationery Office, 1939.) 7*s*. 6*d*. net

THIS publication deals with those aspects of meteorology which are of importance in aviation; but as most of the subject-matter is the common ground of meteorology, the book will appeal to many who are not directly concerned with aviation. It is intended primarily to cover the meteorological syllabuses laid down for the various air navigators' and pilots' licences, and so supplies a long-felt want.

To some extent the information is presented in an encyclopædic, albeit very readable, form, and in this respect the volume recalls the very serviceable Admiralty Weather Manual. The statements that severe hail is "very rare" in the British Isles and that "for really spectacular hailstorms it is necessary to go to tropical and sub-tropical regions" perhaps call for some revision. Hail is a veritable scourge in many parts of central and southern Europe, and in France an elaborate organization for the defence of the vineyards has been in existence for several years (see *Geog. J.*, December 1939, p. 509). L. C. W. B

Psychology

Psychological Foundations of Personality

A Guide for Students and Teachers. By Prof. Louis P. Thorpe. (McGraw-Hill Series in Education.) Pp. xvi + 602. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21*s*.

THE author is assistant professor of education in the University of Southern California. His book is one of many on personality and compares very favourably with most.

Prof. Thorpe has wisely left out the usual string of illustrative cases which contrive to spoil most books on the subject and are usually a complete waste of time to read. Most readers have ample clinical material of their own; to those who have not, cases usually add confusion and a certain superficiality.

After reading books on personality, the present reviewer always wonders, Is the world any better for all this? Time alone will show.

The Family meets the Depression

A Study of a Group of Highly Selected Families. By Prof. Winona L. Morgan. (Institute of Child Welfare, Monograph No. 19.) Pp. x + 126. (Minneapolis: University of Minnesota Press; London: Oxford University Press, 1939.) 9*s*. net.

THIS is a study of the economic stability and psychological adjustments of several hundred families drawn from different parts of the United States. A prior study of the same families was carried out in 1927 and the present investigation was planned with the purpose of discovering any effects due to the intervening five-year period of economic depression (1927–1932). A comparison is made between the earlier and later results. The sample of families was relatively homogeneous as regards socio-economic status. The general outcome, according to the author, seems to favour the family as a social institution.

Biographies of Child Development

The Mental Growth Careers of Eighty-four Infants and Children; a Ten-Year Study from the Clinic of Child Development at Yale University. Part 1, by Dr. Arnold Gesell; Part 2, by Dr. Catherine S. Amatruda, Dr. Burton M. Castner, Dr. Helen Thompson. Pp. xvii + 328. (London: Hamish Hamilton, Ltd., 1939.) 15*s*.

GESELL'S valuable contributions to the field of mental growth and developmental norms in infancy need no introduction. The present work by Gesell and three associates is the result of cumulative observations carried out over a period of ten years, on eighty-four infants and children. A wide diversity of cases, mostly typical and touching many aspects of child psychology, is to be found in this study. The primary aim of the authors is to assess the prognostic value of the normative criteria used at the Yale Clinic of Child Development. The book is carefully written and may be recommended to psychologists in Great Britain.

Psychopathic States

By Prof. D. K. Henderson. (Thomas W. Salmon Memorial Lectures.) Pp. 178. (London: Chapman and Hall, Ltd., 1939.) 8*s*. 6*d*. net.

THE Salmon Memorial Lectures for 1938 were delivered by Prof. D. K. Henderson of Edinburgh. They deal in a very fascinating manner with the problem presented by the psychopath and his many bizarre disorders of conduct.

It is difficult to make the lay mind understand that these mental disorders can occur and usually

do occur in individuals who are of normal intelligence. They are disorders of conduct and as such are very difficult to deal with; further the law is frequently no help and the individual too cunning to help society, often his greatest enemy.

Physics

Cosmic Rays and Mesotrons

By Dr. H. J. J. Braddick. (Cambridge Physical Tracts.) Pp. x + 68. (Cambridge: At the University Press, 1939.) 5*s*. net.

IN a subject that has been developing as rapidly as that of cosmic rays, the writing of books is a difficult and often not very fruitful task. Anything in the nature of a treatise is as yet impossible, and treatment of special branches may be out of date by the time a book can be prepared and published. But special circumstances have enabled the author of this work to avoid this pitfall. The small size of the Cambridge Physical Tracts, in this case only 65 pages, calls for extreme condensation, but makes possible rapid publication. Revision has been made to June 1939, so the book may be considered as up to date as is humanly possible. The author does not pretend to cover completely the whole subject. The first part is a useful digest of the more significant experimental results, while the second is a review, from the theoretical side, of the passage of cosmic rays through matter, and in particular of the shower phenomenon. One chapter is devoted to the mesotron, and contains the evidence for assuming the existence of a new particle of mass intermediate between the proton and the electron. There is also a short discussion of its theoretical implications.

A selected bibliography will enable the reader to pursue the subject more deeply.

Absolutkolorimetrie

Von Prof. Dr. A. Thiel. (Arbeitsmethoden der modernen Naturwissenschaften.) Pp. xv + 215. (Berlin: Walter de Gruyter und Co., 1939.) 10.80 gold marks.

PROF. THIEL is to be congratulated on the clear and comprehensive account which he has given of his work on the application of colorimetry, which has enabled him to elaborate a technique whereby many inorganic and organic substances can be quantitatively determined optically with an accuracy not before achieved by this method of analysis.

The book is divided into two parts, in the first of which is explained the general principles of colorimetry, the technique used and the apparatus employed. The second section gives details of the practical application of Thiel's method of analysis for the quantitative determination of both inorganic substances and of many organic compounds which are of special interest to biologists and medical workers, notably the vitamins and hormones.

The book is a welcome addition to the essential text-books of chemical and biological laboratories.

A Text Book on Light

By Dr. A. W. Barton. Pp. x + 426 + 6 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 8*s*.

THERE are several features of interest in this new book on light by the headmaster of King Edward VII School, Sheffield. The method of presentation is historical, but only "in the sense that the discovery of facts and the development of ideas is presented as they occur historically". There is an unusually good account of Newton's experiments and of his deductions from the facts of observation. It is then pointed out how the mass of evidence grows until one theory fails and another has to take its place. The author adopts the convention as to signs which counts distances measured from the pole of a refracting surface in the *same* direction as the initial direction of the light positive, and the diagrams in the book are drawn with the incident light travelling from left to right so as to give agreement with the usual convention of coordinate geometry. Special mention must be made of the beautiful photographs supplied for the plates by Mr. J. W. Cottingham of Barnsley Grammar School and Dr. J. W. Mitchell of Repton School.

A Text Book of Applied Hydraulics

By Prof. Herbert Addison. Second edition, revised and enlarged. Pp. xii + 435. (London: Chapman and Hall, Ltd., 1938.) 21*s*. net.

THE issue of a second edition of Prof. Addison's manual is evidence that it has served the purpose which he had in view in writing more especially for "those whose work is not directly connected with hydraulics, but who require to be kept in touch with the main outlines of hydraulic practice".

The new edition makes good a deficiency in the earlier issue in that it contains a useful bibliography of the works to which allusion is made in the text, and there is an additional chapter devoted to propeller and screw pumps. A commendable feature is the number of examples with solutions, numbering 125 and occupying 73 pages. These should be helpful to the teacher, as well as to the student reader who may be working without oral help.

The author is careful to point out that hydraulic formulæ, purporting to be based on identical data, can, and often do, yield different results. This warning is particularly necessary in the case of students and young engineers, who are apt to imagine that a formula is an infallible, as well as a labour-saving, device.

Theoretical Mechanics

A Vectorial Treatment. By Prof. Carl Jenness Coe. Pp. xiii + 555. (New York: The Macmillan Company, 1938.) 21*s*. net.

IN this book on theoretical mechanics, Prof. Coe, of the University of Michigan, has adopted from the outset the methods and notation of vector analysis, which provide a language common to all the branches of mathematical physics. His aim has been to present an introduction to classical mechanics, and through

it to mathematical physics, which shall make clear the postulates on which they rest, and at the same time to explain and apply the basic principles of the vector method. He claims that this approach has proved its value in teaching and enables the student to use vector analysis in his later work. The book, which may be confidently recommended, contains sufficient material for an introductory and an advanced course.

TECHNOLOGY

Principles of Mechanism

By F. Dyson. Third edition. Pp. vii + 364. (London: Oxford University Press, 1939.) 12*s*. net.

FIRST published in 1928 and now already appearing in its third edition, this text-book has fully proved its adequacy for the purpose for which it was written. This was to present the fundamental principles which apply to the moving parts of machines in a sufficiently comprehensive manner to satisfy the requirements of those studying for the engineering degree or for the examinations of the engineering institutions. The line taken by the author was to develop the theory of machines in logical sequence from the well-known principles of mechanics, of which a summary was given in the first chapters. That the third edition exhibits no substantial change in the structure of the book, beyond a number of additions made necessary by the increasing scope of the examination syllabuses, is evidence of the sufficiency of this method of presentation.

The additions fall into two classes, the first of which includes a description, explanation and analysis of the pre-selective epicyclic gear-box. Such an example requires very careful treatment, as each operative gear is a combination of simple mechanisms, and here the method of analysis has been set out in full detail, thus giving the student a lead which should enable him to deal successfully with any other complication of epicyclic gears. The second class of additions comprises several of the more difficult examples of the determination of the acceleration of points in mechanisms. There is an acceleration diagram for a quick-return motion fully explained in the appendix, and as this case is more difficult than that of the simple link mechanisms, this constitutes a very welcome piece of extra information for the student. The exact mathematical analysis of the acceleration of a piston and that of a follower in contact with a cam face of straight or circular outline are also new. What the student will greatly value is the clear, direct, and unambiguous style in which the author expresses himself.

Colour Cinematography

By Major Adrian Bernard Klein. Second edition, revised and enlarged. Pp. xxii + 463 + 42 plates. (London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

IN the previous edition Major Klein gave us, in addition to much information and informed criticism on all aspects of motion pictures in colour, first-hand knowledge of the Gasparcolor system. He has since migrated to the Dufay-Chromex concern and now treats us with details of the Dufay system, the commercial difficulties, and the brilliant way in which they have been met. Perhaps we shall not get the full story of the most used colour process until he is acquired by Technicolor. The text remains a most useful historical summary of the subject, a guide to the present application of scientific principles in a difficult branch of commercial engineering, and a severe criticism of usage. Of particular mention are the Dufay printing and mitigation of moiré, the treatment of beam-splitter cameras, the development of suitable light-sources, and the calculation of filter transmissions. We wish other publishers would emulate the gay colours of the binding.

L. E. C. H.

Wissenschaftliche Photographie

Eine Einführung in Theorie und Praxis. Von Prof. Dr. E. v. Angerer. Zweite gänzlich neubearbeitete Auflage. Pp. vii + 211 + 3 plates. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 13.60 gold marks.

THIS volume is addressed to the scientific worker who uses photography as a tool rather than to the specialist in photographic technique or theory. Thus the book is written in a style easily understood by anyone with a rudimentary knowledge of physics and chemistry. It describes the nature of the photographic emulsion, its sensitometry and treatment after exposure in considerable detail. The production of the positive print, colour photography and the camera itself are only described to an extent sufficient to make the book complete. This is as it should be, for the main concern of such a book is to guide the experimenter to find the best possible conditions for obtaining the most satisfactory negative. It is, however, more than a photographic manual, for it contains much interesting information for the reader with only a casual acquaintance with photographic methods.

H. W. M.

The Art of Soaring Flight

By Wolf Hirth. Translated from the German by Naomi Heron Maxwell. Pp. 214. (London: *Sailplane and Glider*, 1938.) 5*s*.

AN English translation of the work of Wolf Hirth, one of the pioneers of soaring flight, was called for by reason of the rapid strides made in the art during recent years in Great Britain and America.

The translator says: "No student of soaring flight can ever hope to achieve success without an understanding of certain meteorological phenomena which are clearly explained in this book, and I feel that the reader will find every page both stimulating and interesting". There are accounts of storm-flying and interesting information on the obstruction of fronts by mountain ranges and the like. Sailing in the air, to a greater extent even than on water, raises a host of meteorological questions which would otherwise never be thought of.

L. C. W. B.

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to secure co-ordination between the scientific departments of the fighting Services and the Ministry of Supply, and the extent of the co-operation between the British and French Governments in these matters. Lord Strabolgi said he did not wish his remarks to be interpreted as hostile to the Government, and he paid tribute to the strength of the recently appointed Advisory Council of Scientific Research and Technical Development The reply elicited from Lord Chatfield, Minister for the Co-ordination of Defence, was informative and important as indicating the extent to which the knowledge and services of men of science are being utilized.

Lord Chatfield paid a tribute to the value of scientific research to the Services The existing establishments were in the main created after the War of 1914–18 or during its later years. They now include many of the leading men of science in the country, either in a working or advisory capacity. He referred to eight research laboratories under the Department of Scientific and Industrial Research, and said: "Generally it is perfectly correct to say that the scientific talent of this country is fully mobilized to its fullest advantage and runs into a very large number of scientists, to be numbered rather in thousands than in hundreds." There is no central organization for dealing with inventions, which actually constitute only a small part of the scientific work in progress Each Service department and the Air Raids Department of the Ministry of Home Security has its own organization for dealing with inventions, and there is constant consultation between these bodies.

Dealing with the exchange of scientific knowledge between the British and French Governments, Lord Chatfield said that co-operation had begun before the outbreak of war, and that there is now "complete exchange of scientific information". Members of the scientific organizations of the two countries are working in each other's establishments. Further efforts are being made, however, to extend the present liaison. Steps are under consideration to safeguard the interest of inventors, and it is likely that machinery similar to that used during the War of 1914–18, namely, a Commission of Awards to Inventors, would be adopted.

Science and War

PROTECTION of civilian population from attack by deadly weapons that science has created is set forth as one of the paramount duties of science in the present emergency, in the annual report by Dr. Vannevar Bush, president of the Carnegie Institution of Washington, recently issued. The same science which saves life and renders it rich and full, also destroys it and renders it horrible. Is it then possible to remain in a detached atmosphere to cultivate the slowly growing body of pure scientific knowledge, and to labour apart from the intense struggle in which the direct application of science now implies so much for good or ill? As science has produced a weapon, so also can it produce in time a defence against it. Science is dedicated to the advance of knowledge for the benefit of man. Here is a sphere where the benefit might perhaps indeed be immediate, real and satisfying. Can a scientific worker, skilled in a field such that his efforts might readily be directed to the attainment of applications which would afford protection to his fellow-men against such an overwhelming peril, now justify expending his effort for any other and more remote cause?

Although immediate participation of the men of science in the safeguarding of civilization is urged by Dr Bush, he gives the warning that we should not become stampeded. "There is still a duty to keep the torch of pure science lit, and this duty is only the greater under stress. All the long struggle of a harsh evolution, the pitting of species against the environment, has produced a being whose primary distinction is conscious cerebration, and whose crowning attribute is his intellectual curiosity concerning his complex environment and a thirst for knowledge transcending the mere struggle for existence. If there is no abiding value in a Beethoven symphony, or a theory of the cosmos, or the tracing of an ancient culture, then the Carnegie Institution of Washington has scant reason for existence. If it is really good that man should look at the stars and should contemplate his great destiny, then it is imperative that in those regions which enjoy the blessings of peace the search for the eternal verities should continue."

Recent Earthquakes

AFTERSHOCKS of the earthquake of December 26 in Turkey continue to be felt in widely separated areas. The epicentres are by no means confined to the Erzinjan-Erbaa area, thus lending support to the original estimate from Istanbul of a depth of focus of the original earthquake of the order of sixteen miles On January 17 eight rather violent tremors were felt in the original area and other violent tremors were experienced at Istanbul, Smyrna, Castamouni, and Izmid. A *Times* report states that at the last-named place an entire hill slid downwards, blocking the road to Kandira. No further casualties are reported from these areas. On January 16 an earthquake occurred at the village of Balcikoy near Nigde, causing two hundred houses to collapse, killing five people and injuring sixteen The death roll was small because a light foreshock preceded the principal shock, causing people to run out of doors. On January 17 at night, two more violent earthquakes were felt at Nigde, which is in southern Anatolia. These caused four hundred houses to collapse, killing fifty people and injuring a hundred and sixty others. A. Hée of the central seismological bureau, now at Clermont-Ferrand (France), has taken the readings of fifteen observatories and determined the epicentre of the original shock to have been near latitude 39·5° N., longitude 38·2° E.; initial time 26d. 23h. 57m. 23s. G.M.T.

An earthquake of intensity VII. and approaching intensity VIII on the modified Mercalli scale of 1931, was felt in Palermo at 2.18 p.m. (local time) on January 15. Much damage is reported to have been

caused to the façade of the monumental church of St. Anna, one of the oldest in Sicily; some damage has been done to the Cathedral, and cracks have appeared in many walls of the poorer type of building. Two people have been killed by falling masonry and twenty-five injured. The electricity supply was temporarily out of action. The earthquake was the most severe for many years, and alarm was caused especially amongst children and people in the poorer quarters of the city. According to a *Times* message, the epicentre of the shock is estimated to have been between Palermo and the islands of Ustica and Alicudi to the north-north-west of Palermo, which would be approximately 38·5° N, 13·25° E. This is in a relatively highly active region seismically, and earthquakes occurred near to this epicentre on August 17, 1926 (38·5° N., 15° E.) and August 21, 1930 (39° N., 14·5° E.). The great Messina earthquake of December 28, 1908, which has been described by Davison, affected this area, according to Baratta, though the epicentre was, of course, somewhat to the east of the present one.

From 1.30 a.m. on January 17, and continuing for three hours at intervals, Paris experienced earth tremors so slight that they were not felt by anyone. The tremors were recorded on the seismographs at the Paris Observatory.

Native Races and Tuberculosis

SOME interesting data bearing upon recent theory of the racial incidence of disease are brought together and discussed in relation to tuberculosis in the *Lancet* of January 13. The older view ascribed the apparently selective action of the infection on native races mainly to innate biological differences, but there is now a tendency to emphasize work and living conditions—with the consequent risk of intense exposure and deficient resistance—on one hand, and the factor of bacteriological immunity on the other. Thus a recent view is quoted in which there is represented a balance between heredity and environment. The emphasis now being laid on social factors, it is suggested, opposes the defeatist attitude that native races are just 'different', and indicates lines of action within human control.

In support of this view, attention is directed to the situation at present in India and Africa. On the Rand, although the incidence among natives working in the mines has fallen considerably in recent years, the incidence among natives in the Union has probably fallen little, if at all. All cases discovered in the mines are repatriated at once and the majority are dead in two years. Thus there is a continuous stream of infectious men returning to the territories from which are derived a return stream of new recruits. There are no sanatoria and little provision of public medical service. In India, a similar situation has arisen in the interchange between urban and rural areas which the growth of industrialism and transport facilities has made possible, with the result that Bengal alone is said to have a million cases of tuberculosis and a hundred thousand deaths annually.

Analysis of the data of the incidence of tuberculosis among non-European or primitives would seem to justify the contention that the problem is now most serious where native agricultural populations are becoming industrialized. That the situation is remediable is indicated by the situation under the Russian Soviets, where rapid industrialization has been accompanied by expansion of the tuberculosis services, with the result that there has been a notable decline in tuberculosis mortality. The writer in the *Lancet* concludes with the admonition that it is the white man's responsibility that the situation in the British Empire should be squarely faced.

Mental Disease in Peru

IN a recent paper (*Amer. J. Psychiat.*, **96**, 403; 1939) Dr. Horatio M. Pollock states that the care of the mentally sick in Peru has gone through a series of progressive stages similar to that in the development of psychiatric science in the United States. A long period of neglect was succeeded by one of inadequate care in almshouses or asylums, which in turn was followed by so-called hospital care with some degree of medical attention, and finally scientific treatment in a modern hospital. The first hospital treatment for mental patients in Peru was provided in the seventeenth century in two general hospitals at Lima, one being St. Andrew's Hospital for men and the other the St. Anne's Hospital for women. Towards the middle of the nineteenth century the special section in the St. Andrew's Hospital became an independent unit with a special physician to look after the patients, and in 1859 a new building named "Hospital de la Misericordia" for mental patients was opened in the outskirts of Lima with accommodation for 160 patients. It was divided into four sections, respectively for quiet cases, those periodically disturbed, mental defectives and epileptics, and violent cases.

In 1918 an entirely new hospital for mental patients, which was named after its benefactor Victor Larco Herrera, was opened at Magdalena del Mare about four miles from Lima with accommodation for more than a thousand patients. The treatment in this hospital has been modernized, and at the present time compares favourably, according to Dr. Pollock, with that in many hospitals in the United States. A single hospital, however, is not sufficient for all the persons requiring mental treatment in Peru. At least two more are needed, and funds are not yet available for enlargement of the present building.

Higher Education in Malaya

"HIGHER EDUCATION IN MALAYA" (H.M. Stationery Office, 2*s*. 6*d*.) is a thorough and most valuable survey. It includes the whole background of teaching and adds an able summary of the resources of the country, mainly due to the rubber plant, and the variety of its population, Chinese, Indians and Malays. The last-named have only been under Western civilization for 60–70 years. They do not dwell in towns like the Chinese. Raffles College, opened in 1928, is the main centre of advanced education, and is

increasingly appreciated by parents, who recognize the value of its teaching. One of the difficulties is that English is learnt as a foreign language; so that subject can scarcely be taken, as at the University of London, with Middle English and Anglo-Saxon as necessary adjuncts. It would be like studying Latin in early and medieval sources as well as Virgil and Cicero. The Commissioners urge that the standard of the London degree should be attempted and some modification of the English course allowed, tending to special knowledge of English masterpieces.

The present diploma of the College is not recognized outside Malaya, and not much progress can be achieved without some external assistance in the examinations, which could be managed by the use of air-mail. The professors take leave once in three years, which puts rather a heavy burden on their substitutes, but gives them a chance to meet external examiners. The present arrangements for a president are inadequate, and the "high wastage rate" of failures needs to be reduced. Several drastic improvements are suggested. We regret to notice that science teaching in the schools is generally in a very backward state, and biology has been scarcely begun. The King Edward VII College of Medicine at Singapore is well equipped and does good work within its limits; but it needs a larger scope, particularly regarding public health.

International Journal of Agrarian Affairs

THE first International Conference of Agricultural Economists was held ten years ago. As the period elapsing between meetings is now three years, some means of maintaining an interchange of ideas, beyond the issue of the proceedings, seemed desirable. The *International Journal of Agrarian Affairs*, the first number of which has just been published, is a bold attempt to meet this need. Two numbers will be brought out each year, the intention being to develop a series of studies on economic and social problems, one such problem being dealt with at a time. The *Journal* will therefore serve as a complement rather than an addition to the statistical year-books of agricultural information which are already available. The kind of topics which will form the subject-matter are those common to all countries, and the aim will be to emphasize the universal concern with the solution of such problems, and to discuss them from all possible angles.

The first number deals with the problem of surplus agricultural population. Contributions are made from such widely different localities as Harvard University, Edinburgh, Washington, Quebec, Sofia and Riga. The theoretical basis of the problem is first discussed and an account given of the historical influence of landowning. Other writers stress the effect of policies of restriction on trade and on movements of population between countries, and describe the special problems of Bulgaria and Latvia, while as regards remedies the development of subsistence holdings is advocated. Though not actually the official organ of the International Conference of Agricultural Economists, the *Journal* will be issued free to all members. For non-members the price is 3*s*. 6*d*., or £1 per volume of six numbers (including postage). All subscriptions and communications should be addressed to the Editor, 3 Magpie Lane, Oxford.

Meteorology in Iraq

THE third annual report of the Director of the Meteorological Service of the Government of Iraq, which covers the year ending March 31, 1939, shows that, owing to the difficulty of obtaining the necessary staff, the basic organization of the Service had not been completed by that date. For example, although new offices were available at Nasiriya and Diwaniya, no staff was available to man them. At the headquarters station at Baghdad, continuous records of wind, temperature, humidity and rainfall were maintained and were analysed and published in the Monthly Weather Report. Upper winds were measured three times a day, and the results appeared in the I.C.A.N. summaries published by the Meteorological Office, London, up to December 1938. After that month they were published in Iraq together with similar summaries obtained from stations maintained by the Air Ministry, Meteorological Service, Habbaniya.

Meteorological information continued to be supplied to civil aviation from Baghdad and Basra, the number of messages rising to 1,200 per month during the winter. As the volume of air traffic over Iraq continued to increase, difficulty was experienced in maintaining this part of the service, and the need for an extension of the existing wireless service was felt. As was only to be expected, the report contains little of purely scientific interest. Owing to the fact that air-conditioning engineers were constantly asking for data concerning the dust content of the air, the Director placed an order for an Owens settlement dust counter and for the necessary microscope for measuring the records.

Lantern Slides

THE cost of making lantern slides from illustrations may be materially reduced by using paper negatives, and Mr. G. H. Bell, of the Physiological Institute, Glasgow, gives an account in the December issue of the *Journal of Scientific Instruments* of a method he has found very satisfactory. He uses "Kodaline Paper Slow" exposed for three minutes at *f*/11, the illustration being illuminated by four 100-watt lamps placed just behind the camera lens. He develops with Kodaline developer and gets a pure black and white negative. He prints on gas-light lantern plates using a mask and giving an exposure of 8 seconds for a surface intensity of 65 foot-candles, uses an energetic developer and gets a slide with black lines on a perfectly clear background both for line diagrams and half-tone illustrations.

Drift of the *Sedov*

THE Northern Sea Route Administration of the U.S.S.R. is preparing for press a collection of articles and other material relating to the remarkable drift of

the icebreaker *Sedov* in the Arctic, the crew of which was reported to have been taken off the icebound vessel by the icebreaker *Joseph Stalin* on January 13. The *Sedov* commenced her drift on October 23, 1937. The book being prepared for press tells the story of the *Sedov's* unprecedented drift. It contains articles by I. D. Papanin, head of the Northern Sea Route Administration and leader of the North Polar Expedition on the drifting icefloe of 1937–38, and by Prof. N. N Zubov, and diaries of members of the *Sedov's* crew

Clough Memorial Research Fund

THE Clough Memorial Research Fund of the Edinburgh Geological Society was instituted in 1935 for the purpose of encouraging geological research in Scotland and the north of England; the north of England is defined as comprising the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. Under the terms of administration of the Fund, a sum of approximately £30 is available annually. Applications for grants are invited for the period April 1, 1939, to March 31, 1940. These applications should state the nature of the research to be undertaken and the amount of grant desired. Applications must be in the hands of the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than March 1

Royal College of Physicians: Lectures

THE following lectures have been arranged by the Royal College of Physicians to be delivered at the College, Pall Mall East, London, at 2.30 p.m.: Mitchell Lecture (postponed from 1939), Dr. F. G. Chandler, "Some Observations on the Diagnosis and Treatment of Pulmonary Tuberculosis" (February 7); Milroy Lectures, Dr R. E. Smith, "Acute Infectious Diseases at School" (February 13 and 15); Goulstonian Lectures, Dr W D. W. Brooks, "The Pathology and Treatment of Pulmonary Tuberculosis" (February 22, 27 and 29); Bradshaw Lecture (postponed from 1939), Dr. J. C. Spence, "On the Nature of Disease in Infancy" (March 7); Oliver-Sharpey Lectures, Prof. E. P. Cathcart, "The Mystery of Alimentation" (March 12 and 14); Croonian Lectures, Dr. George Graham, "Recent Advances in Diabetes Mellitus: Aetiology and Treatment" (May 16 and 21).

Royal Aeronautical Society: Lectures

ARRANGEMENTS are being made by the Royal Aeronautical Society to resume part of the lecture programme which was postponed on the outbreak of war. It is hoped to arrange definitely for four or five lectures. The first one, on aircraft production, will be given by Mr. H. J. Pollard, on March 12 at 6.0 p.m., in the Institution of Electrical Engineers. Sir Alan Cobham and Mr. Marcus Langley have provisionally agreed to give a joint lecture on flight refuelling in the air; Mr. A. A. Hall on recent theoretical and experimental work on turbulence; Wing Commander T. R. Cave-Brown-Cave on noise and nuisance in aircraft, at dates to be fixed. The Wilbur Wright Lecture will be delivered at the end of May.

The Night Sky in February

DURING this month, the night shortens in the latitude of London by 1¾ hours. The moon is new on February 8 and full on February 23. Lunar conjunctions with the planets occur as follows: with Venus on February 11d. 21h., with Jupiter on 12d 14h., with Saturn on 14d. 3h., with Mars on 14d. 4h. It will be seen from these conjunctions that the bright planets are a striking feature in the evening skies, enhanced by the presence of the crescent moon. On February 13 at 8h., Mars, which had overtaken Jupiter on January 7, is in conjunction with Saturn, while on February 20 at 22h., Venus and Jupiter are in conjunction. On February 28, Mercury is at greatest elongation (18° east) and should be visible low in the west after sunset, leading the train of five bright planets, in addition to Uranus (stellar magnitude 6) in the constellation Aries The planet Neptune, which transits about 2h. in mid-February, approaches the 8th magnitude star, B.D. + 3° 2549 (Lalande 22237) on February 14. The light variation of Algol (total variation mag. 2·2–mag. 3·5) is best seen about 1½ hours before and after the following epochs: February 8d. 4·5h., 11d. 1·3h, 13d. 22·1h. and 16d. 19·0h.

Announcements

PROF. MAX BORST, professor of morbid anatomy at Munich, has been awarded the Goethe Medal for art and science on the occasion of his seventieth birthday for his work on cancer.

SIR HUMPHRY ROLLESTON, chairman of the executive committee of the Imperial Cancer Research Fund since 1924, and Sir Thomas Dunhill, sergeant-surgeon to the King, were admitted to the honorary fellowship of the Royal College of Surgeons of England at a meeting of the Council on January 11. Sir Hugh Devine, president of the Royal Australasian College of Surgeons, has accepted the honorary fellowship subject to the condition of personal attendance at the College at some future date.

THE number of births in France, which was 1,022,000 in 1876, fell to 750,000 in 1930 and 616,000 in 1939. For the last three years the number of deaths has exceeded the number of births by 14,000 annually.

DR. FRANS VERDOORN, formerly of Leyden, Holland, has now gone to the United States. Dr. Verdoorn controls the following publications: *Chronica Botanica*, New Series of Plant Science Books, "World List of Plant Science Institutions", "International Address Book of Plant Taxonomists", *Annales Bryologici* and other bryological publications. All communications concerning these should now be addressed to Dr. Frans Verdoorn, Chronica Botanica Co., c/o the Arnold Arboretum, Jamaica Plain, Mass., U.S.A.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN

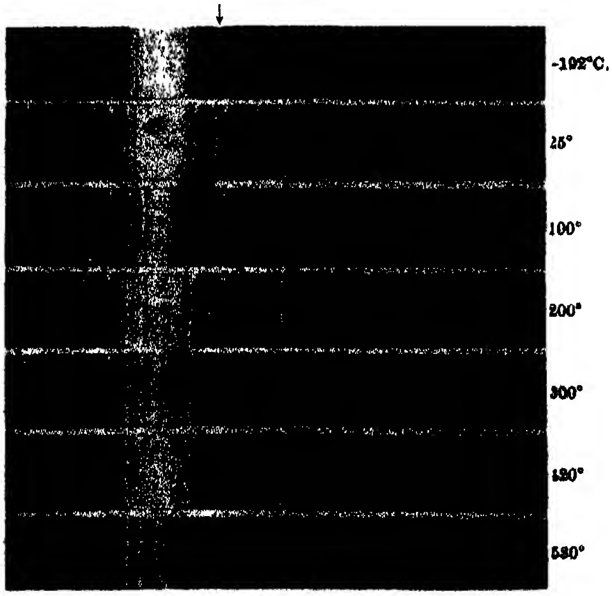
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 151. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The α-β Transformation of Quartz

As is well known, the ordinary form of quartz which has trigonal symmetry changes over reversibly to another form which has hexagonal symmetry at a temperature of 575° C. Though the transformation does not involve any radical reorganization of the internal architecture[1] of the crystal and takes place at a sharply defined temperature, it is nevertheless preceded over a considerable range of temperature (200°-575°) by a progressive change in the physical properties of 'low' quartz which prepares the way for a further sudden change, when the transition to 'high' quartz actually takes place. The thermal expansion coefficients, for example, gradually increase over this range of temperature, becoming practically infinite at the transition point and then suddenly dropping to small negative values[2]. Young's moduli in the same temperature range fall to rather low values at the transition point and then rise sharply to high figures[3]. The piezo-electric activity also undergoes notable changes[4,5].

In the hope of obtaining an insight into these remarkable phenomena, a careful study has been made of the spectrum of monochromatic light scattered in a quartz crystal at a series of temperatures ranging from that of liquid air to nearly the transition point. Significant changes are observed which are illustrated in the accompanying illustration, reproducing part of the spectrum excited by the 4358 A. radiation of the mercury arc. A fully exposed spectrum at room temperature indicates fourteen different normal modes of vibration of the crystal. At liquid air temperature, the three most intense lines correspond to the frequency shifts 132, 220 and 468 cm.$^{-1}$ and are all about equally sharp. As the crystal is heated over the temperature range 200°–530°, notable changes occur. The 220 cm.$^{-1}$ line (marked with an arrow in the reproduction) behaves in an exceptional way, spreading out greatly towards the exciting line and becoming a weak diffuse band as the transition temperature is approached. On the other hand, the other intense lines having both larger and smaller frequency shifts continue to be easily visible, though appreciably broadened and displaced.

The behaviour of the 220 cm.$^{-1}$ line clearly indicates that the binding forces which determine the frequency of the corresponding mode of vibration of the crystal lattices diminish rapidly with rising temperature. It appears therefore reasonable to infer that the increasing excitation of this particular mode of vibration with rising temperature and the deformations of the atomic arrangement resulting therefrom are in a special measure responsible for the remarkable changes in the properties of the crystal already mentioned, as well as for inducing the transformation from the α to the β form.



LIGHT SCATTERING IN QUARTZ.

C. V. RAMAN.
T. M. K. NEDUNGADI.

Department of Physics,
Indian Institute of Science,
Bangalore.
Dec. 11.

[1] Bragg and Gibbs, *Proc. Roy Soc*, A, 109, 405 (1925)
[2] Jay, *Proc. Roy. Soc*, A, 142, 237 (1933).
[3] Perrier and Mandrot, *C.R.*, 175, 622 (1922).
[4] Osterberg and Cookson, *J. Frank. Inst.*, 220, 361 (1935).
[5] Pitt and McKinley, *Canad. J. Res.*, A, 14, 56 (1936).

First Benedicks Effect in Gas-free Mercury, as Influenced by the Mean Temperature

IN a previous letter[1] we have shown that, in mercury carefully freed from gas ions, the First Benedicks effect exists with a positive sign, whereas in the presence of gas ions the effect had shown a negative sign. The influence of gas ions actually seems thoroughly to modify the thermo-electric properties of some metals.

In view of the fundamental character of this influence, the experiments on mercury have now been repeated, using a strangulation apparatus made of silica, with a new heating arrangement (hot and cold flowing oil), and also a photographic registration method. Fig. 1 exemplifies the registrations finally obtained: in the upper parts are to be seen the relay-amplified deflections of the galvanometer, showing small oscillations due to Brownian movement; below, the corresponding temperature registrations.

The new observations were found entirely to confirm the positive character of the effect in gas-free mercury. They further reveal a new, important fact.

From a quantitative point of view, the effect is determined by the formula

$$u = K \cdot \frac{3}{\Delta t} \qquad (1)$$

The parameter K, depending on the metal and, to a certain extent, on the apparatus used (here No. 20), and hence now designated as K_{20}, has been calculated from the observations, using (1), and plotted as ordinates in Fig. 2, where abscissæ are the mean temperatures t_{med}.

It will be seen that the effect varies with the temperature, *increasing in a strongly accelerated way*.

It is interesting that this increase, with increasing temperature, of the First Benedicks effect appears to be just the same as that which has been discovered earlier for the reversed effect, the Second Benedicks effect[2], and which presents a striking similarity to the well-known Richardson formula, valid for electron emission from glowing metals. It actually appears plausible that the emission of electrons along a steep temperature gradient in the metal may follow the same law as the emission into vacuum.

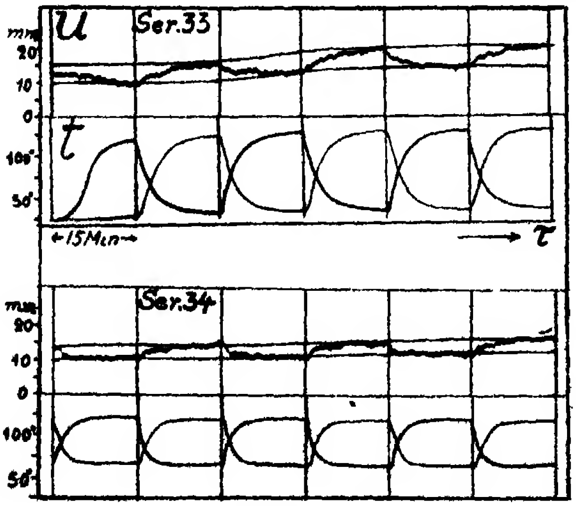


Fig. 1.

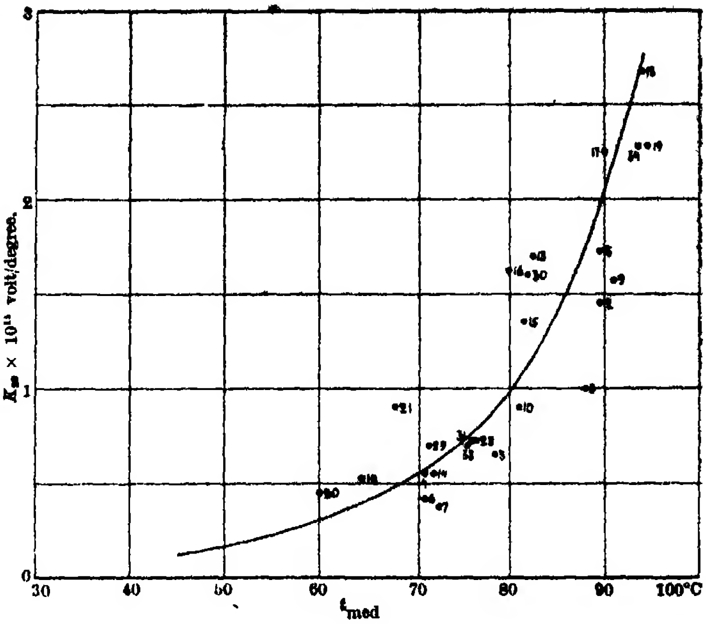


Fig. 2.

FIRST BENEDICKS EFFECT IN MERCURY.

C. BENEDICKS.
P. SEDERHOLM.

Metallografiska Institutet,
Stockholm.

[1] NATURE, 141, 1097 (1938)

[2] Benedicks, C., and Siljeholm, G., *Ark. Mat. Astron. Fys., Stockholm*, 24 A, No. 7 (1933), (see Fig. 41).

Magnetic Anisotropy of Diphenyldiacetylene

E. H. WIEBENGA has recently determined the crystal structure of diphenyldiacetylene[1], $(C_6H_5).C{:}C.C{:}C.(C_6H_5)$. The molecule is plane, with a straight carbon chain, the length of the molecule making angles of approximately 48°, 52°, 78° with the a,b,c axes of the monoclinic unit cell. (By inadvertence, the complements of the first two angles were given in Dr. Wiebenga's letter in NATURE. He has since very kindly sent me the exact direction cosines determined by means of a Fourier analysis, and has also provided me with some beautiful crystals for this investigation.)

The magnetic anisotropy of the crystals, weighing about 4 mgm. each, density 1·170 gm./c.c. at 20° C., was determined by Krishnan's second method in a field of some 7,000 oersted. The minimum diamagnetic susceptibility was determined by the flotation method. The principal crystal susceptibilities are $\chi_1 = -93{\cdot}8 \times 10^{-6} (\pm 0{\cdot}5)$, $\chi_2 = -188{\cdot}0 \times 10^{-6}$, $\chi_3 = -109{\cdot}6 \times 10^{-6}$, $\psi = -88{\cdot}5°$. Hence the mean

susceptibility is $-130\cdot5 \times 10^{-6}$, as compared with $-115\cdot9$ for tolane and $-102\cdot9$ for diphenyl. Pascal's rules would give $\bar{\chi} = -129\cdot7$ for diphenyldiacetylene: he himself found the value $-129\cdot3$ (corr.). The principal susceptibilities of a single molecule, deduced from the above data and the molecular direction cosines, are $K_L = -109\cdot4$, $K_M = -75\cdot3$, $K_N = -206\cdot7 \times 10^{-6}$.

Comparing these with the corresponding values for tolane[2], $K_L = -81\cdot5$, $K_M = -67\cdot8$, $K_N = -198\cdot5 \times 10^{-6}$, it will be seen that there is an abnormal increase of susceptibility along the carbon chain axis, indicating a concentration of electron density normal to that axis. This is in sharp contrast to the behaviour of chains of conjugated double bonds, for which the increase of susceptibility is always normal to the plane of the molecule, indicating a concentration of electron density in that plane. An exact Fourier analysis of the structure of diphenyl is very desirable, in order to extend the comparison from tolane to diphenyl.

Kathleen Lonsdale.

Royal Institution,
Albemarle Street,
London, W.1.
Jan. 9.

[1] Wiebenga, E. H., Nature, 143, 980 (1939).
[2] Lonsdale, K. Proc. Roy. Soc., A, 171, 564 (1939).

Crystal Structure of Phosphorus Pentachloride

Although much work has been done on the molecular structure of phosphorus pentachloride, no crystal structure determination of this important substance has previously been made, presumably owing to experimental difficulties. In our separate laboratories, independent X-ray diffraction experiments have given the following results: Crystal system tetragonal, approximate cell dimensions $a_0 = 9\cdot2$, $c_0 = 7\cdot4$ A., density *circa* $2\cdot0$ gm./c.c., 4 molecules per unit cell, space group $P4/n$.

This information is sufficient to determine the constitution of the compound. Consideration of the space group symmetry and the available space shows that it is impossible to form a structure containing PCl_5 molecules of any configuration. For similar reasons the constitution $[PCl_4]^+Cl^-$ may also be rejected. An ionic structure containing tetrahedral $[PCl_4]^+$ and octahedral $[PCl_6]^-$ groups completely satisfies the requirements. For a unit cell with origin as in the "Internationale Tabellen zur Bestimmung von Kristallstrukturen", the centres of $[PCl_4]$ groups are at 000, $\frac{1}{2}\frac{1}{2}0$, and those of $[PCl_6]$ at $0\frac{1}{2}z$, $\frac{1}{2}0z$, $z \approx \frac{1}{4}$. Preliminary Fourier analyses have confirmed these conclusions, and further details of the structure will be given later.

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D. Clark.

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University Museum,
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A. F. Wells.

Crystallographic Laboratory,
Cambridge.
Dec. 22.

Degeneracy and Dissociation Constants

The importance of degeneracy in enhancing the stability of radicals such as triphenylmethyl has been emphasized by many authors; for example, Pauling and Wheland[1], Ingold[2], etc. This being so, it is strange that no relations have been suggested between complexity of degeneracy (which we may define in terms of the number of possible resonating structures) and dissociation constants of series of related acids and bases. It is probable that simple relations will be discovered only in series where the inductive effects of substituent groups are negligible, or can be eliminated.

Consider the series of acids, methyl alcohol (K of the order 10^{-16}), acetic acid ($K = 1\cdot75 \times 10^{-5}$), phenylacetic acid ($K = 4\cdot88 \times 10^{-5}$), and diphenylacetic acid ($K = 11\cdot5 \times 10^{-5}$). (All K values, which are thermodynamic ones, have been taken from Dippy's recent article[3].) Now the inductive effect of the C=O group moment fails to account for the enormous increase in strength (the ratio being 10^9) when we proceed from methyl alcohol to acetic acid, for chloracetic acid is only 100 times as strong as acetic acid. However, two resonating structures ($n = 2$) are possible for the acetic acid molecule ion, and the energy of resonance effects stabilization.

In the same way, the inductive effect of the phenyl group, which must be very small, will not account quantitatively for the acid strengths of phenylacetic and diphenylacetic acids. Even if we assumed (wrongly) that the increase in K in going from acetic to phenylacetic acid is due to an electrical inductive effect of the phenyl group generally designated as $-I$, the strength of diphenylacetic acid is definitely larger than what we should deduce on that hypothesis. It seems fairly obvious that the enhanced stability of the phenylacetic and diphenylacetic acid ions is due to an increase in the number of resonance

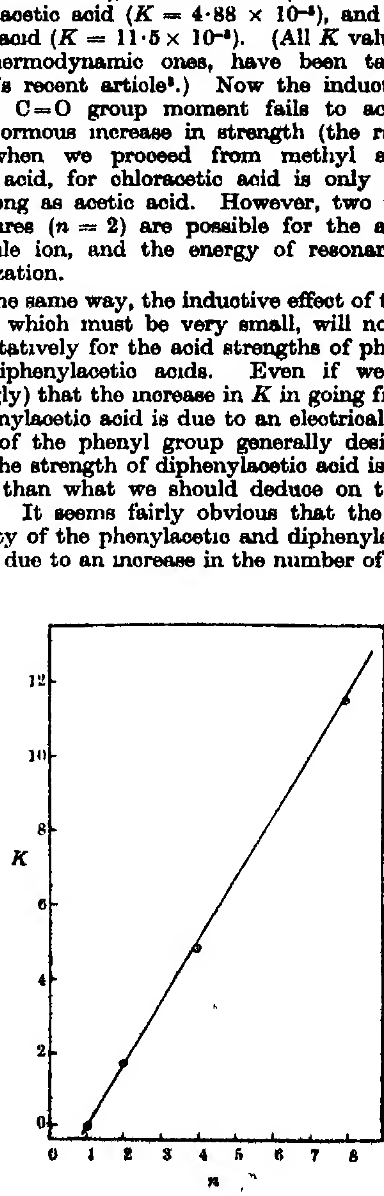

Fig. 1

possibilities, for it is easy to show that $n = 4$ and $n = 8$ respectively, and a linear relation (see Fig. 1) exists between K and n for the three acids. A fourth point for the line is provided if we assume that a non-resonating 'acetic acid' ($n = 1$) would have a strength of about 10^{-13} or zero on our scale. (Dippy and Lewis[4] have already identified the apparent intrinsic attraction for electrons exhibited by the phenyl group with its unsaturated character.) The dissociation constant of triphenylacetic acid in water has not been measured on account of solubility difficulties. Its strength may be predicted by extrapolation to $n = 16$ as $K = 25 \times 10^{-5}$.

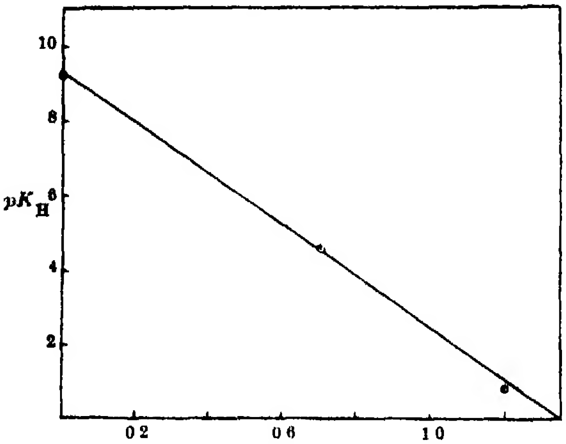

Fig. 2

In the case of a series of related bases, ammonia ($pK_H = 9{\cdot}27$, $n = 1$), aniline ($pK_H = 4{\cdot}62$, $n = 5$), diphenylamine ($pK_H = 0{\cdot}85$, $n = 16$), and triphenylamine ($pK_H = 0$, $n \gg 30$), it is the unionized molecule which is preferentially stabilized by the resonance energy. (Unlike the ion, the unionized molecule has a lone pair of electrons.) In Fig. 2 a plot is shown of pK_H against log n, and again a linear relation is found This method of plotting is more convenient on account of the large difference in basicities. Triphenylamine has zero pK_H as predicted by the relation.

These methods of plotting are really equivalent to plotting the dissociation constant against the total resonance energy involved as n is increased. Each additional structure contributes equally to the actual hybrid state of the molecule. An examination of the dissociation constants of related series of compounds (and activation energies when reacting) will probably yield just as much valuable information about the relative importance of structures as heat data, internuclear distances, and electric dipole moments have already done.

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Dec. 6.

[1] *J. Chem. Physics*, **1**, 862 (1933).
[2] *Trans. Farad. Soc.*, **30**, 52 (1934).
[3] *Chem. Reviews*, **25**, 151 (1939).
[4] *J. Chem. Soc.*, 1008 (1937).

Predaceous Phycomycetes from Cotswold Leaf-Mould

DRECHSLER[1] has described in America more than a dozen species of Phycomycetes parasitic on nematodes and terricolous amœbæ. These he places in the Zoopagaceæ, a family of uncertain taxonomy, related to the Mucorales. To the best of my belief, no members of this family have been recorded in Europe, with the possible exception of some organisms described by Penard[2] in 1913, and placed by him, probably incorrectly, in the Saprolegniaceæ. It may be of interest, therefore, to record the finding of four species of Zoopagaceæ in plate cultures inoculated with leaf-mould from wooded areas in the Cotswolds.

Cochlonema verrucosum, Drechsl., is endoparasitic in soil amœbæ. Infection begins by a conidium becoming attached to the pellicle of an amœba, and sending out a germ tube which enters the host and forms a mycelium within the endoplasm. This mycelium is thalloid, at first sub-spherical, becoming sausage-shaped, and finally twisted in a close spiral, usually of about one and a half turns. The diameter of a mature hypa is about 6 µ. Growth takes place at the expense of the host's protoplasm; but the host remains active until the parasite reaches an advanced stage. Multiple infection is usual. Finally, the host becomes immobilized and dies. Reproduction then occurs by means of chains of aerial conidia, borne on conidiophores usually 1·5 µ in diameter. The conidia are fusiform, 7 µ long and 1 5 µ in greatest diameter

Sexual reproduction takes place by the union outside the host of slightly unequal gametangia. Zygospores are usually formed between gametangia from different mycelia; they are 10 µ in diameter and are enclosed in a thick wall, bearing on its outer surface twenty or more bullate protuberances.

Cochlonema dolichosporium, Drechsl., resembles *C. verrucosum* in size and habit, and was found attacking *Amœba similis*, Greef. It is characterized by its chains of elongate conidia, which have an average length of 20 µ and greatest diameter 1·5 µ. Like the conidia of *C. verrucosum*, their external wall is considerably sculptured. Zygospores of this species were not observed

Stylopage haplœ, Drechsl., forms a sparsely branching mycelium, the branching being roughly at right angles. The hyphæ are non-septate, 1·2 µ–1·5 µ in diameter, and the cytoplasm is considerably vacuolated. Amœbæ become attached to the hyphæ, which send out dichotomously branching haustoria into the endoplasm of the host; the host eventually becomes completely absorbed, leaving only the shrivelled pellicle attached to the haustorium. Reproduction is by clavate conidia, 15 µ long and 2 µ–2·2 µ wide at the broadest part, borne singly on erect conidiophores 20 µ–30 µ long. Zygospores were not observed.

Stylopage hadra, Drechsl., resembles *S. haplœ* in habit, but is much larger, the rather straight, non-septate hyphæ measuring 4 µ–5 µ in diameter. This species catches nematodes, which become attached to the hyphæ, probably by means of some sticky substance. A bulbous lateral protuberance is formed on the hypha at the point of attachment of the nematode, and, from this, hyphæ grow out and ramify inside the host, absorbing its contents. Ultimately, only the withered integument of the nematode is left, attached to the bulb. Reproduction is by ovoid conidia, 25 µ–35 µ long and 15 µ–20 µ in greatest

diameter, formed terminally on aerial conidiophores which may, by repeated growth, bear several conidia. Zygospores were not observed.

Further details of these and other related fungi will be the subject of a paper to be published later.

I should like to express my thanks to Dr. B Barnes for much valuable advice and help, and also to Dr. C. G. C. Chesters, of the University of Birmingham, for kindly allowing me to use his laboratory.

C L. DUDDINGTON

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Jan. 4.

[1] Drechsler, C, *Mycologia* 27, 6-40, 176 203, 206-215 (1935)
[2] Penard, E, *Arch Protistenk*, 28, 78-140 (1912-13)

Radium Treatment

REFERENCE is made in NATURE of December 9, 1939, p. 973, to a paper (*J. Roy Soc Arts*, Dec 8, 1939) entitled "The Penetration of Rays through the Skin, and Radiant Energy for the Treatment of Wounds", in which I express the view that we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there, and states that the Cancer Act is Great Britain's reply to the question whether monetary influence determines the practice of radium therapy in Great Britain

Radium, a destroyer of living cells in active division, cannot be used to attack cancer without also damaging living normal cells of the circulating blood, etc. It can only be used for accessible cancers in the skin or surfaces of the body, which can be removed in nearly all cases by the knife or the diathermy needle of the surgeon; and these last do not cause necrosis and incurable neuralgias, which have often followed the use of radium. Deaths due to leucopenia have resulted from vain attempts to cure deep cancers by the use of radium in bombs. I can instance the damage done by radium by a case now attending the St. John Clinic and Institute of Physical Medicine; radium treatment of a small epithelioma in the skin on the side of the skull resulted in necrosis of the bone, probably incurable, in an area the size of the top of a sherry glass.

Loss of well-being and an incurable neuralgia were recorded by Mr. Furnival, the late distinguished surgeon, who died not long after radium treatment, in his case of cancer of the throat. Such an intolerable neuralgia was suffered by a relative of mine through treatment of a cancer of the root of the tongue, and he also died of a recurrence; and I have heard of many other such cases. There are good clinicians who hold the view that the use of radium favours the spread of metastases. Radium is popular because it can be used instead of the knife, which people dread, and therefore doctors use it.

X-ray apparatus is now available which operates at a million volts or more, so that radiations approaching those of radium are produced The dosage of radium is controlled by time and filtration; that of X-rays can be further controlled in wave-length and intensity. Radium may be chosen as more convenient for application in such a place as the larynx.

Both radium and X-rays can produce, not only necrosis, but also cancer, and Sir Norman Walker considers that the use of X-rays for lupus should be abandoned. I know of an excellent laboratory servant who, only by continued observation and treatment, is kept, so far, free from cancer resulting from scars due to X-ray treatment of lupus of the face

We know that death has resulted in several workers who licked the paint off brushes when applying luminous, radioactive paint to watch dials, and cancer has resulted from a radium tube being left in the body. Those who mine radium-bearing ore die generally from cancer of the lung.

The *Lancet* (Dec 23, 1939) says, "to ensure that radiation treatment is in charge of really competent workers, and to give opportunities for training therapists, a high degree of centralisation will be more effective than the creation of individual treatments units" "To use both radium and X-rays to the best advantage some surgical training and a good grasp of radiation physics are needed, and for the purpose of the Act clinical knowledge of cancer in all its manifestations as well".

While vast sums have been spent on radium, numbers of poor people have to die, unrelieved, of cancer, in their homes The pressing needs are to spread knowledge, secure prevention where possible, and very early diagnosis, allowing a hopeful removal by the knife or diathermy needle, which can be used by surgeons everywhere, the use of radium or X-rays being reserved for one or two places in the body where surgical operation is very difficult, and to be used by specialists as the *Lancet* suggests There is no trustworthy evidence that radium in weak doses has any beneficial action

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Jan 5

"Evidence for Transformation of Mesotrons into Electrons"

IN our note under this title published in NATURE of January 20, p. 102, we stated in reference to the cloud photographs reproduced that the faint electron track *FG*, leaving the end of the mesotron track "is comparable in density with the tracks of other fast particles" in the photograph This was the case in the original negatives, in the prints submitted for publication, and in the first proofs received, except that in the latter all the tracks were fainter. However, in Fig. 1 of the published note, the track *FG* appears much more pronounced and thicker than in the original prints—being quite obvious while other electron tracks in the same region are scarcely detectable A new set of blocks was made for the final publication; the Editors assure us that no part of Fig. 1 received preferential treatment and suggest that the great intensity of the track concerned may have arisen from a very favourable inclination of its direction with the mesh of the screen used in reproduction.

We take this opportunity of pointing out that the arrow pointing to the δ-track at *E* in Fig. 4 should be about 2 mm. lower.

E. J. WILLIAMS.
G. E. ROBERTS.

"Victorian Socialism"

IN a very interesting essay entitled "Victorian Socialism" which Dean Inge contributed to NATURE of January 13 as if it were a review of my "New World Order", he makes certain statements for which I think it is reasonable to demand documentation. He says that the Nationalists (that is, the Franco rebels) took arms "against those devils in human shape, the Spanish Reds", etc. But is it not a matter of fact and common knowledge that Franco led his Moors against a Liberal Republican Government which had recently suppressed a very dangerous anarchist-socialist rising? (see Sender's "Seven Red Sundays", translated by Sir Peter Chalmers Mitchell, F.R.S.) Further, he gives an explicit account of abominable atrocities committed at Ronda. But surely in NATURE we want something more than an unnamed "American eye-witness" for statements of that sort. Who was he? How can we check his testimony? Is he available for cross-examination? Then about that three hundred thousand men and women "butchered under orders from Moscow". Is there a single respectable scrap of evidence for any part of that statement, which we may find quoted presently as a statement made in NATURE.

H. G. WELLS.

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I HAVE made a careful study of the Spanish horrors, and have accepted none but well-documented evidence. The Ronda story is from a book by Arthur Bryant. I could have found several equally dreadful examples by Spanish eye-witnesses, but some of them I did not care to keep on my shelves. The estimate of 300,000 victims is official; some have put the number much higher. Krivitsky's "I Was Stalin's Agent" is most illuminating; for example, p. 120: "The Ogpu had done a brilliant piece of work. In Dec. 1936 the terror was sweeping Madrid, Barcelona, and Valencia. The Ogpu . . . carried out assassinations and kidnappings. . . . The Soviet Union had a grip on Loyalist Spain, as if it were already a Soviet possession." This book may be enough for my friend Mr. Wells, who is a very honest man.

W. R. INGE.

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Wallingford, Berks.

Scientific Workers and the Armed Forces

THE announcement published in NATURE of January 13, p. 61, "that the operation of the Schedule of Reserved Occupations is being relaxed to enable men at or above the age of reservation in scientific occupations to volunteer in approved cases for service in the Forces" calls for certain comments.

The increase in unemployment among scientists, particularly chemists and biologists, which may be the cause of this relaxation of the schedule and is the cause of much concern in this Association, is largely due to the reduction of 'civilian' research and the impossibility of absorbing all these scientists into direct war research. Through the somewhat uneven incidence of the economy campaign, many lines of research are already in jeopardy; it is only necessary to mention the example of food research. In the leading article of the same issue of NATURE, suggestions are made for new lines of research directly related to the needs of the population in war-time. In addition to such lines of work, there can also be suggested scientific work which is of less direct importance to a country at war but should be inaugurated at once so that its results may be available when required. The most obvious example of this kind of work is research on problems of substitute materials, in which Germany is at present probably ahead of Great Britain.

The fact that chemists and other scientists are now allowed to enlist in the Forces in other than their professional capacity suggests that there is a shortsightedness in the scientific direction of the country.

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(Hon. General Secretary.)

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Points from Foregoing Letters

THE ordinary form of quartz with trigonal symmetry changes at 575° to a form with hexagonal symmetry, the change being preceded by a progressive change of physical properties. Sir C. V. Raman and T. M. K. Nedungadi find an explanation for these effects as a result of an examination of the scattering of monochromatic light in quartz at various temperatures up to the transition point.

The First Benedicks effect (passage of an electron current in a metal subjected to a temperature gradient) in gas-free mercury has been re-examined by C. Benedicks and P. Sederholm. They find that the effect increases rapidly with increase of the mean temperature of the metal, the law of increase being similar to that for the emission of electrons into a vacuum (Richardson's law).

The principal diamagnetic susceptibilities of the diphenyldiacetylene molecule have been measured by K. Lonsdale. A concentration of electron density normal to the carbon chain axis is indicated by a comparison of the results with those previously found for tolane.

Independent X-ray crystallographic examinations of phosphorus pentachloride by H. M. Powell and D. Clark in Oxford and by A. F. Wells in Cambridge have established the constitution of this compound in the solid state. The structure contains tetrahedral $[PCl_4]$ and octahedral $[PCl_6]$ groups.

H. O. Jenkins finds that linear relations exist between the complexity of degeneracy, defined in terms of the number of possible resonating structures, and the dissociation constants of series of related acids and bases.

C. L. Duddington describes four species of predaceous Phycomycetes, belonging to the Zoopagaceae, found in leaf-mould from the Cotswolds.

RESEARCH ITEMS

A Neolithic Trackway

A POSSIBLE Neolithic trackway across the Cotswolds has been traced by Miss C. A. Simpson and Miss Clifford and is described by them in *Geography* of December. It extends north-eastward from Bisley by Duntisbourne, Chedworth and Northleach to the edge of the low and swampy ground of the Windrush valley west of Bourton-on-the-Water, where it swings north and then west towards Nutgrove and beyond. In Neolithic times the limestone plateau of the Cotswolds was probably covered by low scrub and there were few trees The valleys, however, were mainly floored by clay and sand, and afforded marshes which restricted the crossing places On the plateau the trackway is less easy to trace, for it was probably less well defined. Long barrows in conspicuous places were probably landmarks and also the objectives of some of the travellers. Flints and stone weapons are also useful clues. On the valley sides, however, the track is frequently sunk either in clay or limestone outcrops. Projecting spurs of firmer ground often lead to the river crossing. In some places the route follows a line of present road, but more often it is marked, if marked at all, by a narrow lane, a bridle path or even a double line of hedge The authors' discussion of the evidence to be sought in tracing the trackway has many useful indications for such work.

Feet of Melanesians and Europeans

A STUDY of the footprints of sixty-five natives of the Solomon Islands by Clifford S. James, of the Melanesian Mission Hospital, Malaita (*Lancet*, 237, Dec. 30, 1939), affords material for contrast with those of Europeans. The longitudinal arch exists in both Melanesians and Europeans and is a definite fixed part of the anatomy. This is contrary to the view recently expressed that there is no fixed arch "in primitive races who have never worn boots or shoes". As regards differences between the foot of a European and the Solomon Islander, that of the latter is more massive and broader, especially in the male, lacking the 'elegance' (usually pathological) of the European foot. The toes of a native are straight, lie parallel with the ground, and are spread out so that the inner and outer borders of the foot are two straight lines. Occasionally the great toe is abducted so that the inner border of the foot is concave medially, and the other foot has to 'step over' the great toe. A native in walking uses his toes more than does a European; and the final push-off is from the toes. The most obvious difference in the two footprints is that the European's foot is always turned outwards to various degrees when walking, while that of the native has its inner border pointing straight ahead with slight variations one way or another. The female foot being less massive than the male, its mobility and pliability are most noticeable, especially as shown in the way the foot spreads out over the ground when the body weight is put on to it. The print of a European aged 5½ years who had never worn shoes, when superimposed on that of a native, showed striking similarities. Flat-foot does not occur among the natives.

Biological Control of a Fungus Disease

THE honey fungus, *Armillaria mellea*, is of world-wide distribution It is widespread upon forest trees in Great Britain, and is very destructive to tea plantations in Nyasaland. R. Leach has made some interesting experiments on biological control of the disease in the last-mentioned venue (*Trans. Brit. Mycol. Soc.*, 23, Pt. 4; December 1939). Forest land has to be cleared of trees before tea bushes can be planted. The fungus attacks roots left in the soil, and later can transfer its parasitism to the economically valuable bushes, with disastrous results. Cutting a ring of bark from trees some time before they are felled, however, depletes the roots of carbohydrates, and thereby deprives *A. mellea* of an acceptable substrate It does, in fact, effect such a large edaphic change that other organisms establish themselves in the decaying roots, and exclude the parasite, which can even be prevented from spreading by felling a bolt of bark-ringed trees

New Descriptions of Agarics

THE Aviemore foray of the British Mycological Society yielded some interesting new records of Agaricaceous fungi, mostly of the genus Russula, which are described by A. A. Pearson in the Society's *Transactions* (23, Pt. 4; December 1939). Several of the species, as *R. rosea*, *R. vinosa and R. gracillima*, have occurred in other countries, but a new species, *R scotica*, is also delineated This is similar to *R. cremeo-avellanea*, which is found in the Pyrenees; but differs in the non-reticulated spore and absence of cystidia on the pileus.

Shoot Wilt of *Prunus triloba*

THE fungus *Botrytis cinerea* is often thought of as a saprophyte, but it has been found to show active parasitism upon some plants. W. C. Moore has recently described a shoot wilt disease of *Prunus triloba*, caused by this organism (*Trans. Brit. Mycol. Soc.*, 23, Pt 4; December 1939). New shoots wilted suddenly shortly after flowering, the bark died and it became brown. A wilted flower cluster was always associated with such shoots, and the disease appeared most severely when the weather was wet before the end of May. Pathogenicity of the organism mentioned was proved by isolation and re-inoculation.

Theory of Differential Periodicity

G. F SLEGGS (*Growth*, 3, 173–179; 1939) puts forward a theory of gene structure and development of the organism which is based on the interactions of protein lattices. If one projects all the genes, cytoplasm and other intergenic material in every cell of the organism into one structure, the author considers that the genes are equivalent to a stack of horizontal lattices differing in spatial period. Growth then is basically a process of lateral extension of the vertical strips of the lattice system. The minimum effective fragment will be a chain of the mesh, for example, the spireme. The equipotentiality of the system lies in the fact that any vertical strip can regenerate the whole differential pattern of the

lattice stack. All genes are thought to be similar, differing only in spatial arrangement. The differential in the amino-acid frequency is believed to result from gene rotation. On this view it is possible to account for differential mitosis, the relationship between cytoplasmic and other intergenic material and growth phenomena, and evolutionary trends by the conception of rotations in a protein lattice stack.

Genetics of *Primula kewensis*

MOST interesting facts have resulted from the examination of *Primula kewensis* by M. Upcott (*J. Genetics*, **39**, 79–100, 1939). There are two types of tetraploids known; the first resulted from the doubling of chromosomes in branches of the diploid cross *P. floribunda* × *P. verticillata*; the second arose from backcrossing the first type to *P. floribunda*. The first contains two complements each of *floribunda* and of *verticillata* chromosomes while the second contains three sets of *floribunda* to one of *verticillata*. The diploid, sterile *P. kewensis* forms bivalents and one to two pairs of univalents. The sterility of the hybrid is not due to difficulties of chromosome pairing. Evidence has been provided of the manner in which gametes with less than the normal reduced number of chromosomes may occur. 8 per cent of the pollen grain division of the tetraploid *P. kewensis* showed "double plates"; that is, either several chromosomes lie off the main divisional plate and form a secondary plate on their own or the mitotic spindle is curved. Should the chromosomes forming the secondary plate be a compatible complement, say $n = 9$, there is a chance of gamete production with 9 chromosomes in place of the normal 18 from tetraploid *P. kewensis*. It is shown that tetraploids have consistently a lower chiasma frequency than the related diploids.

Quantitative Characters

LEROY POWERS (*J. Genetics*, **39**, 139–170; 1939) describes an experiment in *Lycopersicum esculentum* and *L. pimpinellifolium*, in which the analysis of variance is applied to the study of the inheritance of the number of locules and the size of fruit. He shows how the analysis of variance may be usefully applied to genetical problems. Variances were heterogeneous for "between genotypes" and for "between generations" and, to some extent, for "between sampling blocks". The variability of the variances is a function of genotypes. There would appear to be at least three pairs of allelomorphs involved in the determination of both number of locules and size of fruits. Their interactions are geometrically cumulative, but it is shown that interactions between pairs of allelomorphs are different from those within pairs, and proper experimental methods should be adopted to keep these differences distinct.

Greenland Ice Sheet

THE advance and retreat of valley glaciers is frequently cyclic and not progressive in either direction. It is often more dependent on local topography than on changes in climate. In recent observations in north-west Greenland ("Contributions to the Glaciology of North-West Greenland", *Meddelelser om Grønland*, **125**, No. 3), J. W. Wright shows that advance and retreat have occurred in the Moltke Glacier this century, but agrees that other evidence than that of valley glaciers is required for movements of the ice cap. This evidence he believes he has found, pointing to a recent retreat of the ice cap in Inglefield Land. Several new nunataks have appeared during the last few years; their appearance is vouched for by Eskimos. A long narrow lake, on the ice-free land, but adjoining the ice cap, has lately undergone a drop in level as shown by the former strand line; presumably its outlet until recently was dammed by a tongue of the ice which has now disappeared. Further evidence of retreat is the occurrence along the edge of the ice cap of rock not yet bearing the normal covering of lichen. Lastly, Mr Wright cites the disappearance during the last ten years of an ice cap covering a small island and the melting of the snow drifts that were perennial on the slopes east of Thule.

Microseisms and Transmission of Atmospheric Disturbances

As the result of the mathematical examination of an ideal case in which atmospheric disturbance is transmitted through a layer outside or within which a steady air current is blowing, Katsutada Sezawa and Kiyoshi Kanai (*Bull Earthquake Res. Inst. Tokyo Imp. Univ.*, **17**, Pt. 3, 548–557; 1939) arrive at some interesting conclusions. When it is possible for the disturbance to be transmitted through such a layer, the amplitude of the waves becomes a maximum for a certain range of periods, which condition would be one of the important causes of microseismic oscillation. It is possible for there to be two kinds of waves transmitted along this ideal atmospheric layer; one has a velocity comparable with that of sound waves and the other has a velocity of the order of a small fraction of the velocity of sound waves. Waves of both these kinds are transmitted only in the same or the reverse direction of the wind. The condition determining such a direction of wave transmission depends on wind velocities both in the upper and lower atmospheres. It is pointed out that microbarometric records register an aggregate of local disturbances of smaller periods, particularly those of a gravitational nature, and it may not be possible to pick out the main oscillations of smaller periods that occur in a relatively large area. For this reason it may not be possible to show any correspondence between microbarometric oscillations and microseismic oscillations.

Use of Monochromatic Image in the Spectrohelioscope

M. A. ELLISON has published a paper on the formation of the monochromatic image in a spectrohelioscope (*J. Brit. Astro. Assoc.*, **50**, 2; 1940) which will prove very useful to solar observers. As it deals with various details too numerous to summarize in a short space, those who are interested in the subject are referred to the original paper. Briefly, Ellison considers the three possible arrangements for the 'scanning' and 'viewing' slits, and points out the advantages as well as the disadvantages of each one. He refers specially to the convenience when the slits are placed side by side, about five inches apart and parallel to one another, a method adopted by F. J. Sellers, director of the Solar Section of the British Astronomical Association. A description of the apparatus has already appeared (*J. Brit. Astro. Assoc.*, **48**, 6; 1938) and Ellison has used a similar apparatus with his spectrohelioscope, the results being very satisfactory. A short account is given of the Anderson prism device, which is an alternative to the slit mechanism and was applied by Hale to the spectrohelioscope.

FURTHER APPLICATIONS OF THE PHOTOGRAPHIC METHOD IN NUCLEAR PHYSICS

By Dr. C. F. Powell,

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In a letter published in Nature of July 15, 1939, p. 115, attention was directed to the fact that the photographic plate provides a very powerful instrument for investigations depending on the detection and measurement of the energy of heavy charged particles, notably protons, and of neutrons. It was shown that the method, when applied to determining the energies of the neutrons liberated from the light elements under deuteron bombardment, yields essentially the same information as that provided by the expansion chamber. The photographic method has, however, marked advantages over the expansion chamber, which were described.

The first experiments were made on neutrons of which the energy spectrum had already been investigated. It was, therefore, of importance to apply the method to an investigation in which previous work could not serve as a guide able to prejudice the experimental observations. Adequate checks were applied in the previous work and it is believed that the results are free from this objection, but nevertheless an independent experiment was desirable. Through the courtesy of Prof. J. D. Cockcroft and Mr. P. I. Dee, it was possible to examine the neutrons from fluorine under bombardment with 900 kv. deuterons from the Cambridge one million-volt generator. The results are shown in Fig. 1, and are taken from measurements on 1,700 tracks contained in 4 sq. cm. of an Ilford half-tone plate of which the emulsion was 100 μ thick. The results were obtained with an exposure of two hours with 30 microamperes in the resolved deuteron beam, the plate being at a distance of about 10 cm. from the target and in a position to detect forward neutrons. The measurements of the tracks were made by a single observer in about sixty working hours. We understand that the same spectrum has been investigated by Dr. T. W. Bonner using the expansion chamber, and that his results will be published shortly. We have not seen his results, and it will thus be possible to make a completely independent check on the validity of the photographic method. Two tracks of 13·4 eMv protons suggest boron contamination of the target, and this may be responsible for the peaks at 4·3 and 9·0 eMv. Further work will be necessary to decide this point.

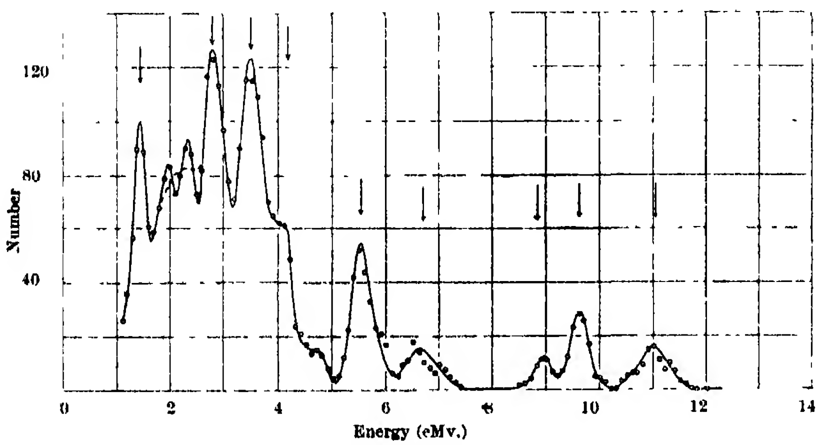

Fig. 1.

Forward neutrons from F + D at 900 kv.

Number per 200 kv. range plotted for every 100 kv. Peaks statistically justified are shown by arrows. Two tracks were also observed, at 13·2 and 13·6 eMv respectively, which suggest slight boron contamination of the target.

It was suggested in the previous letter that the photographic method is equivalent to a continuously sensitive expansion chamber. We believe it possible to press the analogy further in the sense that the spatial orientation of a track in the emulsion can be determined. With objectives of high aperture, the depth of focus is so small that it is possible to determine the depth of individual grains in the emulsion with a high degree of precision, and hence the angle of inclination of a track to the plane of the plate. In addition, the direction of the projection of the track on the plane of the plate can be measured to within a quarter of a degree and the direction in space thus defined. We have examined the distribution in angle of the protons ejected by the neutrons from boron under deuteron bombardment as they pass though the plate.

We and other observers have shown that the high-energy neutrons from this reaction fall into four groups with energies of approximately 4, 6, 8·7 and 13·3 eMv when the bombarding deuterons have an energy of 600 ekv. If a neutron of energy E_0 is scattered by a proton, the energy acquired by the proton, if projected at an angle β with the direction of the incident neutrons, is $E_0 \cos^2\beta$. If we measure the range of protons projected in a photographic plate by the boron neutrons, we should therefore expect the ranges of the observed tracks to be distributed, according to the angle β, in a way corresponding to this energy equation. We should expect the points to lie, not on four lines, but within four bands as a consequence of:

(a) the straggling of the protons,

(b) the uncertainty of $\pm 2°$ in the direction of the neutrons entering the plate, owing to the width of the deuteron beam striking the target, and

(c) an uncertainty of $\pm 1°$ in the determination of β.

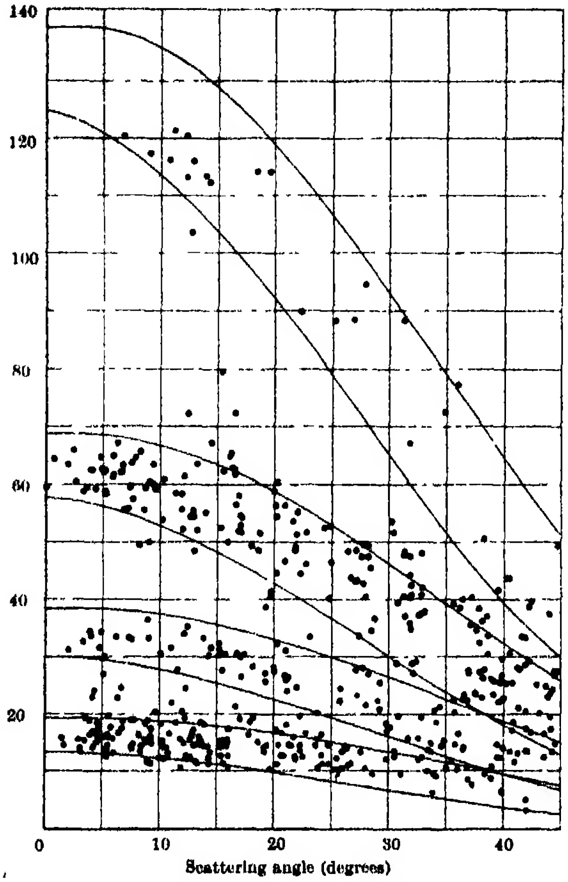

Fig. 2.

DISTRIBUTION OF RANGE WITH ANGLE FOR 500 PROTON TRACKS SCATTERED BY B + D NEUTRONS.

Tracks measured make angles up to $\pm$ 12° with plane of the plate. Range is plotted in microscope eyepiece scale divisions.

The bands shown in Fig. 2 are drawn by assuming a 'width' of 0·8 eMv. in the range at any angle due to straggling, and an uncertainty of $\pm 3°$ in the determination of β due to factors (*b*) and (*c*). The results for the first 500 tracks measured are shown as points in Fig. 2, and it will be seen that 90 per cent of the tracks lie within the four bands. The results emphasize in a striking way one of the conclusions of the previous letter, that the photographic method has the advantage over the expansion chamber in that the amount of matter in the plate is so small that it does not give rise to scattered neutrons in serious numbers, and show that it is possible to investigate neutron-proton scattering at high energies by the photographic method. The measurements are proceeding.

The possibility of determining γ-ray energies by means of the photographic plate has also been investigated. Plates loaded with heavy hydrogen were exposed to the γ-rays from fluorine under proton bombardment and a search made for the photo-disintegration protons. The difficulty is that the cross-section per atom for the production of electrons in the emulsion by the γ-rays is about a thousand times greater than that for the photo-disintegration of the deuteron. Although many electrons must pass through a grain before it will develop, a limit is thus imposed on the time of exposure to which the plate can be subjected, beyond which the general background of fog makes it impossible to distinguish proton tracks. With the first plates available the deuterium content was too small to give a sufficient number of tracks per sq. cm. of the plate at the limiting γ-ray exposure. A layer of 'heavy' ammonium chloride, $(ND_4)Cl$, was therefore supported immediately above an ordinary half-tone plate during an exposure to the γ-rays. A large number of proton tracks was then observed in the developed plate, starting in the surface of the emulsion, and having a maximum energy of 2 eMv. We attribute these to the photo-disintegration of the deuterium under the action of the 6 eMv. γ-rays from the fluorine.

Although the application of the method to the determination of γ-ray energies can only be made in the absence of neutrons, it can be used in its present form to determine the spatial distribution of protons from the photo-disintegration process, an experiment which is of great importance for the meson field theory. This experiment, and further work with plates loaded with greater amounts of heavy hydrogen, is proceeding.

It is evident from the results published in our previous communication on the protons from the reaction $B^{10}-d,p$ that the photographic method can be applied to scattering experiments between fundamental particles, p—p, p—d, p—α, etc., using the high-energy protons provided by the cyclotron, and we are at present collaborating with Prof. J. Chadwick on such experiments. Dr. T. R. Wilkins kindly informs me in a private communication that he is investigating proton-proton scattering at high energies by a similar method. The great advantage of the method for such work is that, in contrast with experimental methods employing counters, the particles scattered through different angles are all recorded at the same time, so that it is not necessary to apply elaborate corrections for maintaining the constancy of the bombarding stream or correcting for its variation. The analysis of the plates is much easier in these experiments than with neutron work, since the scattered particles all start in the surface and run parallel into the plate. Dr. Wilkins employs a camera carrying a large number of plates in this

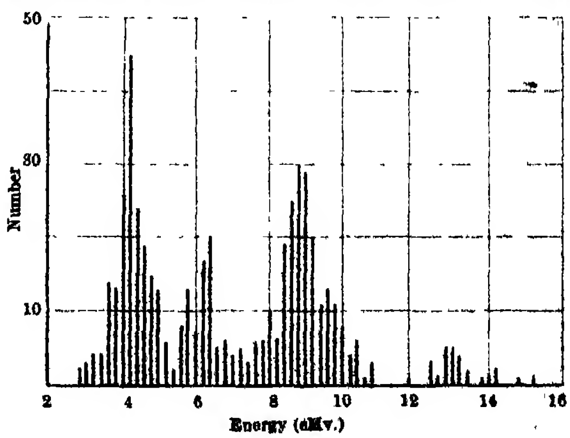

Fig. 3.

ENERGY DISTRIBUTION FROM ALL MEASURED TRACKS PROJECTED WITHIN 40° OF THE DIRECTION OF THE INCIDENT NEUTRONS.

type of experiment. We use a single rectangular plate with the proton beam running parallel to the long axis and a little above the plate. The beam, defined by stops, passes down the axis of a tube provided with a short interruption through which protons scattered by the gas in the camera can emerge to enter the plate.

A detailed account of the methods employed will shortly be submitted for publication in another place. It may be mentioned here that we find it a considerable advantage to use binocular microscopes and optical equipment of the highest quality to reduce the nervous strain on the observer to a minimum. Although the Ilford half-tone plate has proved very adequate for the work, it seems likely that it will be possible to develop special plates with superior characteristics for nuclear work.

THE VOCODER

At the World's Fairs in New York and San Francisco great interest was shown in the speech synthesizer shown in the Bell System exhibits In the December number of the *Bell Laboratories Record*, H. Dudley, of their research department, describes this device, known as the 'vocoder'. The 'voder' is an offshoot of a more extensive system first demonstrated in its experimental stage several years ago. It first analysed spoken sounds and then used the information to control the synthesizing circuit. As World's Fair displays were then under consideration it was seen that the synthesizer, manually controlled, could be made into a dramatic demonstration. Development was at first concentrated in this field, but when a successful Voder became assured, attention was shifted back to the broader and parent system and it was called the 'vocoder', since it operates on the principle of deriving voice codes to re-create the speech which it analyses The analyser is at the left and the synthesizer at the [illegible] vocoder

[illegible] speech waves from a microphone are analysed for pitch by one channel and for spectrum by a group of channels. In the pitch analysis the fundamental frequency is called for simplicity the pitch. It is measured by a circuit containing a frequency discriminating network which obtains the frequency in a pure form, a frequency meter for counting, by more or less uniform pulses, the current reversals therein, and a filter for eliminating the actual speech frequencies but retaining a slowly changing current that is a direct measure of the pitch The output current of the pitch channel is then a pitch-defining channel with its current approximately proportional to the pitch of the voiced sound and equal to zero for the unvoiced sounds.

There are ten spectrum-analysing channels, the first handling the frequency range 0–250 cycles and the other nine, the bands, 300 cycles wide, extending from 250 cycles to 2,950 cycles, a top frequency which is representative of commercial telephone circuits. The operation of the analyser is illustrated by a group of oscillograms taken in analysing the sentence "She saw Mary". In the analyser the speech wave is the input and the eleven speech-defining signals are the output ; in the synthesizer the eleven speech-defining signals are the imput and the speech wave the output. The relaxation oscillator is the source of the buzz, and the random noise circuit the source of the hiss. When a voiced sound is analysed a pitch current other than zero is received, with the result that the buzz is set for the current pitch by the "pitch control" on the relaxation oscillator ; also, the relay marked "energy source switch" operates, switching from the hiss source to the buzz source. From the loud-speaker comes speech approximately the same in pitch and in spectrum as the original

The possibilities of the Vocoder were recently demonstrated by the author before the Acoustical Society of America and before the New York Electrical Society. In these demonstrations comparison is first made between direct speech and the best re-creation that the apparatus could make. Then by manipulation of dials and switches, speech is modified in various ways. Normal speech becomes a throaty whisper when the hiss is substituted for the buzz. Although the hiss is relatively faint, it is shown to be essential for discrimination between words like 'church' and 'shirts'.

Ordinarily the re-created pitch moves up and down with that of the original If variation is prevented, the re-created speech is a monotone like a chant. When the relative variation is cut in half, the voice seems flat and dragging , when the swings are twice normal, the voice seems more brilliant ; when four times normal it sounds febrile and unnatural. The controls can be reversed, so that high becomes low , the tune of a song is then unrecognizable, and speech has some of the lilting characteristics of Scandinavian tongues By appropriate setting of the basic pitch, the voice may be anything from a low bass to a high soprano If the basic pitch is set to maintain a constant ratio of, say, 5 to 4 to the original, this is a 'major third' higher and harmonizes with the original In two-part harmony, the demonstrator can then sing a duet with himself. Connecting a spare synthesizer for a 3 to 4 ratio he can sing one part in a trio, the others being taken by his electrical doubles. Finally, with the basic pitch control of the apparatus, he becomes a father reprimanding his daughter, then the girl herself, and then becomes the grandfather interceding for the child. Keeping careful time with the puffs of a locomotive, the demonstrator can make the locomotive puff intelligibly "We're—starting—slowly- -faster, faster, faster" as the puffs come closer together. A particularly striking effect is that of singing with an organ to supply the tones. Although the words may be spoken, the demonstrator usually sings them to hold the rhythm. It makes no difference whether his voice is melodious or not ; the tonal quality comes only from the musical source.

The engineering possibilities which may grow out of the application of the principles employed in this device are hard to predict at the present time. The speech-defining currents, however, do have features of simplicity and inaudibility which may open the way to new types of privacy systems or to a reduction in the range required for the transmission of intelligible telephonic speech.

CATLIN AND HIS NORTH AMERICAN INDIAN GALLERY AND MUSEUM

By L. J. P. Gaskin

FEBRUARY 1 is the centenary of the opening of "Catlin's North American Indian Gallery and Museum" in the Egyptian Hall, London. George Catlin, American artist, traveller, and ethnographer, spent eight years, 1830–38, among the Plains Indians of North America, and was familiar with their life and customs at a time when the Indians were still living far from that civilization which was to overtake and destroy them so rapidly. His declared purpose from the outset was to preserve for posterity the likeness of aboriginal man in America, and his artistic ability and industry in this direction was shown to great advantage by more than six hundred portraits and sketches of the Indians, and of Indian life, hung round the walls of the Egyptian Hall. The Museum contained thousands of objects of Indian manufacture such as weapons, costumes, musical instruments, and domestic utensils so arranged as to form a pictorial history of those tribes thought particularly worthy of notice. In the centre of the room was erected a large wigwam from the country of the Crow Indians, made of buffalo skins, curiously ornamented with porcupine quills, and capable of housing eighty persons.

The history of the exhibition is interesting. After a four-year sojourn in London and the provinces it was removed to Paris, where it attracted the attention of Louis Philippe, who permitted it to be shown in the Louvre. Unfortunately, this Royal interest involved Catlin in great difficulties when the July Revolution of 1848 compelled him to leave France. Once again in London, he sought to recoup his losses by the rehabilitation of his exhibition, and this led to financial disaster: his collections were seized for debt, though they were freed later through the generosity of a fellow-countryman.

In 1852, Catlin set out on his travels once again, and on this occasion visited Central and South America. He returned to Europe in 1858, and busied himself with the formation of his "Cartoon Collection", copies of his original pictures, and much new matter from his later travels. He returned to America in 1870 to show this second collection in the Smithsonian Institution, and died in 1872.

For forty-two years he had laboured to improve and perfect his Indian collections, and to plead the Red Man's cause. His writings, particularly his "Letters and Notes on the manners, customs, and condition of the North American Indians" (1841), made him and his work known to a large circle of readers in Europe and America, and his portraits and sketches have been declared, by those well qualified to judge, as among the most truthful of the Red Indians ever presented to the public. But the most enduring monument to his memory will always be his two collections, now housed in the United States National Museum and the American Museum of Natural History.

NEWTON'S KNOWLEDGE OF THE RADIUS OF THE EARTH

IN a paper entitled "The Story of Newton's Inverse Square Law and his Use of a False Radius of the Earth" (*J. Brit. Astro. Assoc.*, **50**, 2; 1939), John Miller states that the story of Newton's alleged ignorance of the true radius of the earth is open to considerable doubt. The data at the disposal of Newton were the time the moon required to revolve around the earth and the moon's distance from the earth in terms of the earth's radius. The latter was known from the days of Greek astronomy to be about 60, and this was independent of the true radius of the earth. A few simple formulæ are derived by Mr. Miller, and from these a relationship is established between the true radius of the earth and certain constants, the basic assumption being the inverse square law. Miller's final formula enables the true radius of the earth to be found, but, of course, if a false value of the radius is used in this formula, the equality breaks down; in other words, the inverse square law seems invalid. It is alleged that Newton took the radius of the earth to be 3,440 miles, and as it was impossible to fit this value in with the inverse square law, his work was delayed nearly twenty years.

It is generally believed that Newton accepted the value of one degree of latitude as 60 miles, hence his difficulty with the fictitious radius of the earth, but, as Miller points out, Snell's measurement in 1617 gave 66·6 miles and Norwood showed in 1637 that 69·5 miles was a close value, while two years later Picard found a more accurate result, slightly less than Norwood's. It is remarkable that Newton did not make use of any of these in 1665–66 when he was engaged on his gravitational theory at Woolsthorpe. It is certain that he knew Snell's value in 1672, ten years before he was supposed to have recomputed his earlier results, because Varen's "Geography", published in 1672, contains an error which Newton corrected by using Snell's value for the length of a degree of latitude. Picard's accurate results were communicated to the Royal Society in 1672 on the day that Newton was elected a fellow, yet the story goes that he did not make any use of these until 1682. This delay of ten years seems inexplicable.

From an examination of the evidence from various other points of view, Mr. Miller concludes that the story is unauthenticated and that the real reason for Newton's delay of seventeen years in the publication of his "Principia" was the difficulty that he experienced in dealing with axial rotation, a problem to which Miller hopes to return in a subsequent paper.

ELECTRICITY AND GAS INSPECTION SERVICES IN OTTAWA

THE annual report of the Electricity and Gas Inspection Services of Ottawa for the fiscal year, ended March 31, 1939, has been published (Ottawa: King's Printer. 25 cents). It is addressed to the Department of Trade and Commerce, and describes the activities of the Electricity and Gas Inspection Branch from March 1938 until February 1939, with the work performed during the previous year. So far as the Electricity and Gas Inspection Services are concerned, the work performed creates a record. The total revenue was £2,400 more than the preceding year and there were 21,000 more meters tested. A decrease in the surplus is mainly due to the fact that the salaries of the headquarters staff are included in the statement for the first time. The amounts required to cover rent, fuel and furniture for the Services as a whole are not included in this summary. The expenditures incurred in the administration of the Electricity and Fluid Exportation Act are included in the amount charged against electricity inspection. This amounted to about £40.

Calorific tests of manufactured gas were made throughout the Dominion and the average heating value was found to be 489 B.T.U. per cubic foot. The standard required is 450 B.T.U. per cubic foot. The amount of natural gas supplied throughout Canada during this period was approximately 32,000 million cubic feet, an increase of 5½ millions over last year. The total number of meters in service on March 31, 1939, was approximately two million, an increase of nearly 60,000 over the preceding year.

The periodic calibration and checking of the inspection standards, supplied to the various inspectors throughout Canada for outside companies and other departments of the Government, is performed in the laboratories of Ottawa, Winnipeg and Vancouver. The expenditure on electricity inspection was £55,000 and on gas inspection was £15,000.

The number of kilowatt-hours of electrical energy produced for export during the fiscal year 1938–39 was 1,940 million, an increase of 100 million over the preceding year. The number of kilowatt-hours produced for use in Canada by the exporting companies was 3,100 million electric units, as compared with 4,132 million during the previous year. The revenue collected by virtue of the export duty of 0·03 cent per electric unit shows a slight increase over the preceding year.

The Range Oil and Gas Company exported approximately 289 million cubic feet of natural gas from the Rogers Imperial structure in southern Alberta during the past year; and the Vanalta Oils, Ltd., exported approximately 27 million cubic feet from the Red Coulee field, also in southern Alberta. No revenue, except the licence fee, ten pounds for each licence, is obtained from this export.

THE McCOMB-ROMBERG SEISMOMETER

MODELS of this new tilt-compensation seismometer have recently been placed in the new seismographic station of the Nebraska Wesleyan University in Lincoln, Nebraska, in the Chicago Seismograph Station, and in Salt Lake City ("New Instruments and Equipment at Coöperative Seismograph Stations of the United States Coast and Geodetic Survey", J. H. Nelson and H. E. McComb, *Bull. Seis. Soc. Amer.*, 29, No. 4, 549–588; Oct. 1939).

A few of its salient features are as follow: It rests on a one-piece brass plate having point-slot-plane positions for the seismometer footscrews. Around the edge of this base plate is a ploughed slot in which the edges of the metal cover rest. Air currents and dust are effectively kept away from the boom and optical system. The column is relatively short and well braced against possible side sway. At the top of the column a worm-driven windlass provides easy and accurate adjustment of the length of the supporting wires from which the steady mass is suspended. The boom, a duralumin rod about 12 in. long has at one end a sapphire jewel which rests against a steel pivot mounted in the bottom of the column, and at the other end a vane of electrolytic copper which floats in the field of a cobalt steel permanent magnet. A rough auxiliary pivot with slow-motion screw mounted on the column to work against a brass cup on the boom is provided for protecting the main pivot and jewel at times of installation and adjustment. The mass is of brass, weighing 2,550 gm. The boom, damping vane and oil cup weigh about 130 gm. The magnet is mounted on guides and may be readily removed at times of determining free period and recording decay curves. The air gap may be easily adjusted by means of a knurled-head micrometer screw.

The optical system of multiplying lever and mirrors gives a nominal magnification of about 350. The seismometer cover is of thin sheet aluminium, provided with doors for adjustments and a glass window set so as to reflect stray light downwards and not into the optical system. Both the north-south and east-west components record on one Henson recorder. The speed of the drum is 15 mm. per minute (one revolution per hour), translating about 5 mm. per revolution. It is driven by a 60-cycle 110-volt synchronous motor through a train of cut gears. A single seismogram 12 in. × 36 in. in size is obtained. The east-west component records directly whereas the north-south component operates by reflection from a large first-surface mirror which gives no distortion.

SEVENTY YEARS AGO

NATURE, vol. 1, January 27, 1870

Tyndall on Haze and Dust

THE Friday Evening Discourse entitled "On Haze and Dust" delivered by Prof. Tyndall at the Royal Institution on January 21, 1870, is printed in full. Prof. Tyndall referred to experiments carried out at the Royal Institution, in which he passed a "powerfully condensed beam" of light through tubes originally exhausted and "optically empty", to which air from the laboratory was admitted after passing through potash and sulphuric acid. In every case, floating matter entered the tube, and revealed itself by scattering the light, showing the "conical track of the electric beam". If the air was heated before passing through the drying apparatus, the floating matter was burnt up. "It was therefore *organic matter*". Tyndall then tried different methods of heating the air stream. Imperfect combustion of the particles produced fine blue clouds in the experimental tube, which gave perfectly polarized light at right angles to the illuminating beam. He also reported experiments in which a heated body placed below a cylindrical beam of light produced wreaths of blackness like thick black smoke, due to air currents removing the scattering particles which made the beam visible.

Tyndall then went on to associate the "organic matter" which the flame consumes with the germs causing disease. For this he was taken to task in the leading article in the same issue. "Practically, so far as health is concerned, Prof. Tyndall has given us a scientific account, not only of certain optical properties of impure air, but likewise of the benefit of several popular practices, such, for example, as lighting fires during epidemics to purify the air, the use of gauze curtains in malarious districts as a protection against fever, covering the mouth with a cloth during sleep in fever countries, and the like . . On the real proximate aerial cause of disease, if such there be, no new light has been yet thrown either by the optician, the microscopist, or the chemist "

FROM a correspondent: "Professor Struthers, of Aberdeen, and Professor Bell, of St. Andrews, hearing that the five ladies who are studying at the Edinburgh University are excluded from the opportunity of studying anatomy there, have severally offered their services as instructors. Many a lady will rejoice that the numbers of those willing and ready to help in the good cause of fuller knowledge for women are increased by two professors, who have bravely come forward with much moral courage and chivalrous feeling."

"WE are happy to be able to announce that the council of the Chemical Society has decided to have a report of their proceedings and an abstract of the papers read before the society drawn up immediately after its meetings, and to offer copies of this report to the editors of journals who may be likely to wish to publish it. The days when the newest results of science were regarded as something secret—or, at all events, of no concern to the ordinary man of education—are gone by, we trust, for ever."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEMONSTRATOR IN BACTERIOLOGY—The Registrar, University, Leeds (February 8).

AN APPOINTMENT IN THE MECHANICAL ENGINEERING AND TRANSPORTATION (POWER) DEPARTMENT of the Indian State Railways—The High Commissioner for India, General Department, India House, Aldwych, W.C 2 (quoting Appointment 1/4A) (February 12)

LECTURER IN AGRICULTURAL BIOCHEMISTRY in the Massey Agricultural College, Palmerston North, New Zealand—Universities Bureau, 88a Gower Street, W.C.1 (April 15).

TECHNOLOGISTS—The Under-Secretary of State, S.2.G., Department Z.A., Air Ministry, Adastral House, Kingsway, W.C.2 (quoting reference number B.380)

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C 2

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

London Shellac Research Bureau. Bulletin No. 3: Iodine Values of Lac; Reaction between Halogen and Lac. By Dr B. S. Gidvani and Dr. R. Bhattacharya. Pp. 14. Technical Paper No. 17: Ethers and Ether-Esters of Lac and their Polymerisation. By Dr. B. S. Gidvani. Pp. 24. (London: London Shellac Research Bureau.) [31

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1939, with Report of the Director of Water Pollution Research. Pp. iii+49. (London: H.M. Stationery Office.) 1*s*. net. [41

Imperial Institute. The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary (Production, Imports and Exports) 1936–1938. Pp. 453. (London: H.M. Stationery Office.) 7*s*. 6*d*. net. [41

Battersea Polytechnic. Report on the Work of the Session 1938–39, *by the Principal, being the 46th Annual Report presented to the* Governing Body Pp. 36. (London: Battersea Polytechnic.) [91

Friends of the Hebrew University of Jerusalem. Annual Report 1938–9. Pp. 16. (London: Friends of the Hebrew University of Jerusalem) [101

Hull Museum Publications. No. 205: On Dating Old Horse-Shoes. By Dr. Gordon Ward. Pp. v+38+7 plates. No. 206: Excavations at the Roman Town of Brough, E. Yorkshire, 1937. By Philip Corder and the Rev. Thomas Romans. Pp. ii+62+6 plates. (Hull: Hull Museum) [101

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 2, No. 2, September 1939. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+113–196. (London: H.M. Stationery Office) 4*s*. 6*d*. net. [101

Other Countries

Canada. *Department of* Mines and Resources, Mines and Geology Branch: Bureau of Mines. The Canadian Mineral Industry in 1938. Reviews by the Staff of the Bureau of Mines. (No. 804.) Pp. iv+102. (Ottawa: King's Printer.) 25 cents. [91

Publications of the Dominion Astrophysical Observatory. Vol. 7, No. 8. The Spectrographic Orbits of the Components of Boss 2112. By W. E. Harper. Pp. 149–154. (Ottawa: King's Printer.) [91

Field Museum of Natural History. Botany Leaflet No. 24: Mistletoe and Holly. By Sophia Prior. Pp. 30. (Chicago: Field Museum of Natural History.) 25 cents. [91

Scientific Publications of the Cleveland Museum of Natural History. Vol. 8, No. 2: A New Arthrodire from the Cleveland Shale Formation. By David H. Dunkle and Peter A. Bungart. Pp. 13–28+plate 3. (Cleveland, Ohio: Cleveland Museum of Natural History.) [91

Department of Agriculture: Tanganyika Territory. Pamphlet No. 24: Reports from the General Experiment Farms 1938. Pp. 48 (Dar es Salaam: Government Printer.) 1*s*. [91

Transactions of the San Diego Society of Natural History. Vol. 9, No. 14a: A New Subspecies of the Western Worm Snake. By Laurence M. Klauber. Pp. 67–68. Vol. 9, No. 15: Two New Pocket Gophers from the Desert Slope of Eastern San Diego County, California. By Laurence M. Huey. Pp. 69–72+plates 4–5. (San Diego, Calif.: San Diego Society of Natural History.) [91

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1932–33. English Version. Part 2. Pp. 478+15 plates. (Cairo. Government Press.) P.T. 100. [101

Catalogues

Old Books of interest to the student of the Social Sciences. (Catalogue 54.) Pp. 42. (London: E. P. Goldschmidt and Co., Ltd.)

Level Measurement and Control. Pp. 24. (London: Negretti and Zambra.)

Marmite (Yeast Extract) in Medicine and Dietetics. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)

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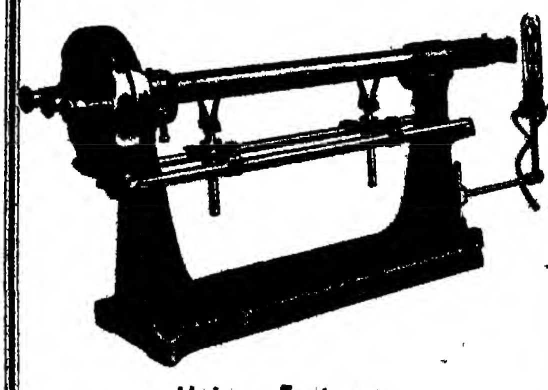

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SCIENTIFIC PLANNING OF LOCAL GOVERNMENT

IT is becoming a commonplace to say that war is no longer an affair of armed forces alone. Curtailed lighting, restrictions on travel whether by road or by rail, national registration, the rationing of food and of petrol, the exigencies of civil defence, and many other measures have brought home to all that national needs and effort must, on occasion, override all personal and individual considerations Nothing can be allowed to stand in the way of our immediate purpose, which is to win the war, with the view of establishing an order based on the peaceful settlement of international disputes.

It would be disastrous, however, if the restraints necessarily imposed on individuals in a time of war engendered merely a sense of frustration Behind even the prosecution of the war lies the purpose of safeguarding our national life and existence, for it is the preservation of our mode of life, with its traditions and heritage of justice and freedom, that has called forth this effort. Nevertheless, the very disturbances and shocks administered to the structure of our national life may loosen obstacles that have hindered its development in the past. Amid all the tragedy and wreckage of war, any opportunity which it may afford to redeem the mistakes of the past should not be forgotten.

There are few fields of planning in which to some extent fresh opportunities are not opening up and possibilities of further progress and development appearing. The organization of national defence has given a fresh impulse to many forces making for regionalism, the co-ordination of local authorities or of public services, the control of the location of industry and like matters. Under the exigencies of war, fresh experience is being gained which should ultimately be of value in the reintegration and development of national life, both under local authority and central government Particularly is it true that the organization of civil defence, whether in the actual precautionary services against air attack or in the dispersal of population in evacuation schemes, has exposed defects in our administrative system which should be rectified at the first opportunity.

Notable among such weaknesses are the difficulties which local administrative units, often with archaic and thoroughly unscientific boundaries, can put in the way of a uniform and adequate plan of defence; and the failure of such bodies to appreciate the differences between urban and rural conditions and to apply measures appropriate and adequate in each sphere. It is not easy to assess the wastage which has been caused by such weaknesses, but an attempt should be made not merely to eliminate such waste but also to deal with its underlying causes.

An outstanding contribution in this field is Dr. W. A. Robson's study "The Government and Misgovernment of London", which appeared a short time before the War broke out. The attention of scientific workers has already been directed to this book in these columns (NATURE, 144, 846; 1939), but much of the third part of Dr. Robson's book is of general validity and far from being confined to the particular question of London. The issues of regionalism, the principles of democracy involved, no less than those of planning, affect more or less acutely, problems of national and local administration throughout Great Britain, and the stimulating discussion of these matters deserves the careful attention of all those who are determined to seize any fresh opportunities which the testing time of war may present.

Regional reorganization, whether in London or elsewhere, is not necessarily a political question in the party system at all. There is little reason to believe that any political party would gain or lose much by the introduction of reform and, in the main, all are in favour of administrative efficiency as they understand it

If, however, on political grounds reconstruction is not likely to meet real difficulties, strong opposition may be encountered from the numerous local authorities whose prestige or even existence might be affected Dr. Robson directs attention to the importance of this appearance of vested interests in local government and to the need for investigation by competent sociologists. There is an obvious need for impartial scientific investigation. The picture of muddle and frustration which Dr. Robson draws is far from being a matter of local concern. The organization of London's government is a national question calling for national leadership and direction Solution of the problem on such scientific lines as suggested by Dr Robson would, moreover, have effects reaching far outside the boundaries of even Greater London Not merely would a great impetus be given to regionalism, but also experience would be forthcoming which would contribute immensely to the wise planning of national resources and the effective handling of the intricate issues involved in the national planning of transport, the utilization of land and the preservation of amenities.

What is clear is that the whole question still offers a wide field for investigation or research. Municipal research is in fact largely unknown in Great Britain, and most municipalities are content to carry out their own investigations independently of the experience or practice of others There is no information service available for municipalities to promote co-operation in the study of problems of municipal administration, and there are few signs of any desire for such co-operation. The recommendation in the report on the location of industry issued by Political and Economic Planning (P E P) for the establishment of a central information service on industrial siting (see NATURE, **143**, 770 , 1939) is essentially a step in this direction, but much more definite study and investigation are required. Regional problems require separate study, and above all study inspired by the belief that regions are not congeries of local units. The need for comprehensive improvement must be admitted, and the investigations prompted by a broader view and higher statesmanship. Only in such a spirit can we hope for effective experimentation with plans for federal or dual metropolitan government, and acquire the basic experience or use it wisely.

When all allowance has been made, however, for the need for fuller investigation on particular issues, it cannot be denied that there is already available an immense amount of knowledge which, if pooled and really utilized, would permit a much more effective co-ordination of national and local resources. The urgent necessity for economy in both local and national administration is a further reason for action Unless some real attempt is made in London and elsewhere to find a regional solution on scientific lines for these interlocked problems of the chains of towns for which Patrick Geddes introduced the term 'conurbation', so far from the resources of the nation being husbanded and expended to the best advantage, we are likely to see yet further waste and frustration, through short-sighted economy starving essential services and neglecting bold and far-reaching measures which would eliminate the meaningless rivalries, overlapping and duplication so often encountered at present

To secure action it is not enough to have an adequate plan and programme. Equally essential is a public opinion among the electorate alive to the possibilities and determined on reform. Unfortunately, as Prof. H. A. Mess pointed out a year ago in an able article in the *Political Quarterly* (**9**, 389 ; 1938), there are factors tending to weaken civic consciousness, and new cohesive devices and new forms of government may be required to develop civic consciousness in, for example, Greater London. At the best, in a new town there is a considerable time-lag before consciousness and sentiment adapt themselves to the new situation, and still longer before there is a change in local government.

This matter of local sentiment and public opinion is not entirely a matter of education. The term 'local sentiment' is ill-defined and often absurd. It would be hard to answer such questions as in whose minds it is found, how widely it is diffused, how strong it is and in what kind of attitudes and actions it results. The analysis by sociologists of such questions as these and others involved in the rise and decay of towns should be as valuable to those faced with the practical problems of administration as to those concerned with the education of the electorate in citizenship.

From whichever side we approach such problems,

whether from that of education, the investigations which lead up to the planning, or the technical aspects and administrative detail of the planning itself, the responsibilities and opportunities of scientific workers are unmistakable If we are to build, with resources impaired if not crippled by the sacrifices and vicissitudes of wartime, a social order in which the advantages which modern science has put at our disposal are more freely and fully utilized, and the present obstacles to that utilization or the forces dissipating our resources have been eliminated, scientific workers must play a major part. No defeatist spirit can be tolerated. Only as men and women, whether scientific workers or not, address themselves hopefully and adventurously to this creative task, ready to seize whatever opportunities may come and resolved that no inherited prejudices or vested interests of administration or property shall be allowed to injure the common welfare, can we hope to build cities and communities which will enjoy the true abundance which might be ours. We must be planning for that future even in the stress of war, if we are to be ready when the opportunity comes to transmute our dreams and visions into the cities, workshops and homes of a new era of civilization.

FUTURE OF ZOOLOGY IN INDIA

A LONG series of volumes, bearing the title of "The Fauna of British India", has been published under the authority of the Secretary of State for India, with the object of ensuring that the rich fauna of that great continental area is made properly known and, at the same time, of providing authoritative means for its identification. While its inception is more than fifty years old, the wisdom in launching this project has become increasingly justified in recent years. The first volume, which dealt with part of the Mammalia, appeared in 1888 The latest volume, also dealing with Mammalia, was issued in 1939 and is reviewed on the next page. Throughout this period, one or more volumes have been issued almost every year. During the War of 1914–1918, five volumes were published.

The "Fauna of India" has become increasingly used in Indian universities, colleges and museums. Furthermore, certain of the volumes rank as essential tools in the work of the scientific staffs of those Government departments concerned with agriculture, fisheries, forestry and tropical medicine; and indeed, certain forthcoming volumes promise to be of special importance in this respect. The "Fauna" series aims at providing accurate descriptions of all species of Indian animals and, thereby, forms the basis upon which further study depends. The importance of accurate identification scarcely needs stressing, whether it be, for example, of a mosquito concerned with disease transmission, an insect devouring a crop or an animal of solely scientific interest.

This primary object of the "Fauna" is being gradually achieved, but there is still a long and uphill road to traverse For one thing, some of the earlier volumes are now out of date and need revision in the light of increased knowledge. Many divisions of the animal kingdom have not yet been dealt with, and there is the added difficulty of finding competent specialists willing to undertake the monographing of certain important groups. The Termites are a case in point, as they rank among the most destructive of Indian insects; little progress is being made in their study, mainly owing to difficulties attending their identification

We learn with regret that the Secretary of State for India has decided to cease publication of the 'Fauna of British India" for the duration of the War While recognizing the present necessity for economy, it needs emphasizing that much of zoological progress in India may become involved in this decision. It behoves those who have such progress at heart to combine their efforts and do all that is possible to discourage any policy directed towards further economy, possibly resulting in the cessation of the publication of the "Fauna of India" altogether. Such an outcome would, in the long run, heavily counterbalance any monetary savings achieved.

The projected dominion status for India is linked with the growing part being played by Indians in the scientific development of their country. In this latter connexion they need every help that we can provide. From the zoological point of view, the least we can do is to ensure the continuance of this long-established publication.

THE MAMMALS OF INDIA

The Fauna of British India, including Ceylon and Burma

Edited by Lt.-Col R B S Sewell. (Published under the Patronage of the Secretary of State for India.) Mammalia. Vol. I : Primates and Carnivora (in part), Families, Felidae and Viverridae By R. I Pocock Pp xxxiii + 464 + 31 plates (London Taylor and Francis, Ltd, 1939) 30*s*.

BLANDFORD'S "Mammals of British India", published in 1888 and 1891, has until now been the standard work on the subject, and useful as that has been, it had for some years been regarded by zoologists as out of date, since a vast amount of additional knowledge on the subject has been gained in the last half century A new edition that would embody the latest views on classification and the experience of sportsmen and travellers was greatly needed, and in 1923 Mr Pocock, an eminent authority on the mammals of the world, undertook the task, little realizing the length of time that would be required owing to the vast amount of material to be handled and examined and the extent to which names of species and races required revision

Formerly species were recognized mostly by their external appearance and local races regarded merely as varieties, whereas now careful measurements of the skulls and, where possible, other parts as well, has to be carried out Well-defined local races are distinguished by the trinomial method of nomenclature

That the work has been done with the utmost pains and thoroughness is clear from a perusal of the present volume, which deals with the orders Primates and Carnivora (in part) Of the former, British India possesses two species of gibbon, *Hylobates hoolock* and *H. lar*, these being the only representatives of the man-like apes, though the more ordinary types of monkeys are well represented by the macaques and langurs or leaf monkeys and the lemurs by the lorises

Of the monkeys proper the author recognizes three distinct races of the rhesus in British India, the typical race occurring throughout nearly the whole of northern India and to a great extent Burma as well. This, the best known of all the monkeys as it is largely imported alive into European countries, although not regarded by the Hindus as sacred, is nevertheless left unmolested and so has become a very familiar object in native villages

The lion-tailed macaque, also known as the wanderoo monkey, is certainly the most striking in appearance on account of the large growth of grey hair surrounding the face and the glossy black hair of the remainder of the body, but it is rare and keeps strictly to the thick forests of the Western Ghats.

Of the small lemurs, or lemuroids, the slow and slender lorises are well known, but research has shown that of the former there are no fewer than four and of the latter six distinct races All are strictly nocturnal, sleeping bunched up in the fork of a tree by day, when they have much the appearance of the little spotted owl (*Athene brama*) and "the same habit of swaying the head and, when fighting, utter a similar screech" At the approach of darkness they creep forth and capture their prey "after a stealthy approach, with a lightning grab of both hands, and hold it in a tenacious grip while devouring it."

The greater part of this volume deals with the Carnivora, in which the author admits that classification is difficult Of the Felidæ the zoologists of old grouped all in the genus *Felis*, with the one exception of the cheetah or hunting leopard which was distinguished by its so-called non-retractile claws; but Mr. Pocock finds that this animal is actually more nearly allied to the ordinary cats than the latter are to the lions, tigers and their near relations. He places the great cats (lions, tigers, etc) in a separate subfamily, Pantherinæ, the more ordinary cats in that of Felinæ, including a number of genera, while the hunting leopard alone occupies the subfamily Acinonychinæ

The lion was formerly abundant in northern India; but is now nearly extinct there, the few that remain being restricted to the Gir Forest in Kathiawar, where they are protected. The author believes that it made its way into India through Persia and Baluchistan in comparatively recent times and was not there long enough to penetrate far southwards Its near extermination has been brought about by human persecution and not, as has often been suggested, by competition with the tiger

This volume will surely rank as a very worthy member of a fine series.

D. SETH-SMITH.

GREY OWL: NATURALIST

Half-Breed

The Story of Grey Owl (Wa-Sha-Quon-Asin) By Lovat Dickson. Pp. xii + 346 + 12 plates. (London · Peter Davies, Ltd., 1939.) 10*s*. 6*d*. net.

"Grey Owl went to his last resting place as he would have wished. . . . As the sun set on Lake Ajawaan, the burial party turned back to town, one hundred miles distant, leaving Grey Owl among the birches and pines he so much loved, at peace in a remote and lovely grave"

THAT was in 1938, and thus was marked the end, at the early age of fifty years, of one of the most intriguing personalities that graced modern times. But it also marked the beginning of a rumpus which raged for some considerable time after his death. Grey Owl or Wa-Sha-Quon-Asin, a self-styled North American Indian, was shown to have lived his younger days in Hastings and attended the Grammar School there. His name was Archie Belaney, and his aunts still live in that town. Had he hoaxed the world, or was there a conundrum demanding thorough investigation? Mr. Lovat Dickson, Grey Owl's friend and confidant, spared no pains in his endeavour to establish the truth. But it seems that the whole truth may never be told. That he was not a full-blooded Indian of the Ojibway tribe is now certain; but that he was a pure 'white' is uncertain. It depends upon the origin of his mother, which so far has not been thoroughly traced But after carefully examining the details meticulously recorded by his biographer, it seems impossible not to believe that he was a half-breed. For if he was not, then much of his behaviour, and indeed his very physical appearance, are incomprehensible.

Interest in that aspect of Grey Owl has naturally died down somewhat, but Mr. Lovat Dickson's book will arouse afresh and with even greater vigour interest in Grey Owl as a human personality and especially as a naturalist. During the present time of increasing interest in the teaching of biology and natural history, the book will prove of inestimable value for the inspiration that Grey Owl has given; for he was no mere sentimentalist where animal life was concerned. True, he loved animals, and in loving them learned *how* to study them, for, as one great zoologist once quoted in parody:

"He studieth best who loveth best,
All things both great and small."

"Here [at Ajawaan] he will live out his days, knowing only these animals and birds that he loves and who love him, sharing in their joys and sorrows, their triumphs and disappointments; watching them mate and sharing their parental triumphs; guarding them as best he can from Death, the only intruder who can do them harm" This is surely field natural history at its best; doubtless an unattainable ideal for most of us who have to live and study in less rural or less congenial surroundings, but at the same time an inspiration to achieve the best methods possible. In schools and colleges, much can be done by keeping and studying animals in captivity. Grey Owl's methods can be adapted to such less ideal conditions, so that the aquatic animals in the aquarium, the frogs in the frog pond, and the rabbits in their run receive the consideration which is their due. Love of Nature will naturally follow (if it is not already there), and just as Grey Owl, through the influence of his wife Anahereo, became converted from a killer to a conservator of wild life, so will students of natural history and biology become imbued with the desire not only to learn but also to preserve It will not be necessary then to teach students, for example, that when gathering material for study only the minimum should be taken, and when they intend to study twigs in winter or summer they should never take even one twig from a sapling, thus disfiguring the tree for life. A host of ideas for field work, too, can be culled from this study of Grey Owl's life.

Even as a boy, Archie Belaney valued animals as living creatures, not as dead trophies. At Hastings he was allowed to keep his "friends", including snakes, frogs, birds, silk-worms, and rabbits, in a room at the top of the house. One is struck by the similarity between this boy and the boy Raymond Ditmars who kept his menagerie at the top of a house in New York. The former finally became a conservator of wild life under the Government of Canada; the latter is a curator in the New York Zoological Park and is still one of America's leading naturalists.

Through his very obvious desire to give a faithful biography of this truly wonderful man, Mr. Lovat Dickson may not even realize himself how much Grey Owl's love of Nature as here recorded will prove a unique source of inspiration to many students of plant and animal life; and

the tenacity and singleness of purpose of Grey Owl is an absorbing study in itself. In his younger days he showed not so much a stubborn impatience with stiff English life as a strict determination to achieve a purpose. He achieved more than his purpose. He learned that it was undignified as well as unwise to take more of the fruits of the earth than one needed. He also achieved a keen sense of values, for he himself wrote: "You still believe that man, as such, is pre-eminent, governs the Powers of Nature. So he does, to a large extent, in civilization, but not on the Frontier, until that Frontier has been removed." Later, of his adopted tribe, he said:

"Nature is to us a sanctuary. To the Indian all Nature is sacred. All things are in accord, all part of the one great plan, Creation. . . . Thus, the Indian attitude towards Nature. Thus his philosophy—that not only man but all living creatures of the forest have a right to live, to freedom, a right to be happy in their own way, a right to a place in the sun."

The book never lacks interest For reasons already given it should be read by teachers of biology, natural history and psychology; all students of these subjects should read it, too, and we strongly recommend that it be given a place on the shelves of school libraries for the benefit of older pupils. Mr. Lovat Dickson's absorbing style transports the reader to the open tracks and great forests of Canada where the sough of the birches and pines can almost be heard, while it seems impossible never to have met Jelly Roll, McGinnis and McGinty and the other animal characters which antic and prattle their parts through the narrative.

This raises a point to which the reviewer would direct the attention of Mr. Lovat Dickson. The book as it stands will be read by, and surely satisfy, many who knew of, and appreciated, the work of Grey Owl; it should also command the attention of biologists and natural historians; but it is not suitable—indeed is not meant—for younger children. For example, Grey Owl's apparent views on marriage would not be compatible with those of the average 'civilized' white man. But Grey Owl obviously loved children as he did other animals. He came into contact with many thousands of young admirers throughout the world. He wrote for them, he lectured to them (only the fact that he refused not to mention the "controversial" subject of fox-hunting prevented him from broadcasting to them during one of his rare visits to Great Britain). A "Life of Grey Owl" suitable for younger children would be a source of inspiration to them—an example of nobility of character (too often left to more warlike heroes to set) and, more important, a leader in the most desirable way of studying life around them.

LANDMARKS IN NEUROLOGY

Selected Writings of Sir Charles Sherrington
A Testimonial presented by the Neurologists forming the Guarantors of the Journal *Brain*. Compiled and edited by D. Denny Brown. Pp. xiv + 532. (London: Hamish Hamilton Medical Books, 1939.) 25*s*. net.

NEUROLOGISTS will open this volume with the highest expectations and will not be disappointed. It is a testimonial to Sir Charles Sherrington made up of extracts from his writings and edited by a colleague who has been in close touch with all his later work. True, it would need an incredibly bad editor to spoil the effect of such remarkable material, but Dr. Denny Brown has been a very good editor indeed. By a careful choice of extracts and the use of occasional connecting passages he has made a series of chapters, each complete in itself and each dealing with a particular theme. Some of the chapters are mainly derived from early papers, for example, on the nerve roots, some from the work at Liverpool or at Oxford, but most of them contain extracts from several sources and show the development of the subject in Sherrington's hands as well as his final judgment on it. We see the detailed mapping of motor and sensory supply, followed by the classical analysis of reflex activity in the spinal animal. Several aspects of reflex co-ordination have chapters to themselves, and considerable space is naturally given to the discussion of reciprocal innervation. One chapter is derived from the paper with Grünbaum on the motor area of the brain, and the last two deal with more recent work on the intimate nature of excitation and inhibition and on the adjustment of muscular contraction. There has been no attempt to include many of the topics dealt with in the book which had such a decisive effect on the progress of neurology, the "Integrative Action of the Nervous System", for the present volume is designed as a companion and a supplement to it.

The editor has done his work so well that the reader very seldom realizes that he has done it at all; there are footnotes to show the composite sources but the chapters have all the freshness and distinction of the original papers, and there is no sense of discontinuity where one extract succeeds another. In his choice of material, too, Dr. Denny Brown deserves our thanks; though with him we may deplore various omissions, his selection covers all the major lines of Sherrington's researches, and is constantly reminding us of the wide range as well as the originality of his work.

Sherrington's primary business has been with the physiology of the nervous system, and this volume is primarily a record of his scientific achievements in that sphere. For many of its readers, however, it will be valued even more as the record of a personality, as a record of Sherrington's way of looking at things, of solving a problem and of writing of what he has done, as a study, in fact, of the behaviour of a remarkable individual, 'C. S. S.' All through the book there are examples of the acute observation which finds so much new meaning in a posture of a cat's hind limbs or a flick of its ear, and of the experimental skill with which a complex act is resolved into its simplest components. For it has been Sherrington's achievement to explain the integrative properties of the nervous system by the analysis of such finished products as standing or scratching. But these chapters reveal much more than the method of approach and the technical equipment of a celebrated neuro-physiologist; they show as well the characteristic outlook and characteristic style which lends a peculiar charm to Sherrington's prose and is essential to the complete picture. In the present volume there are abundant examples of the apt turn of phrase, the striking metaphors and sudden illuminating comparisons which enrich his sentences.

We could have wished for more: this, indeed, is our only disappointment, though Dr. Denny Brown is not to blame. We cannot, of course, have a single volume to illustrate the many qualities of one who inspires such high regard and warm affection in all his colleagues. We should have liked samples of his verse, of his reviews and historical or biographical writing to place beside the strictly scientific papers. In his preface, Dr. Denny Brown lists some of the extracts he would have liked to include. The list is tantalizing, though it does not diminish our gratitude to the editor for what he has done. The testimonial he has given us is worthy of the great man of science to whom it is addressed and will certainly induce the reader to sample 'C. S. S.' in his other moods.

E. D. A.

PROBABILITY AND ITS APPLICATIONS

Probability, Statistics and Truth

By Prof. Richard von Mises. Translated by J. Neyman, D. Sholl and E. Rabinowitsch. Pp. xvi + 324. (London, Edinburgh and Glasgow: William Hodge and Co., Ltd., 1939.) 12*s*. 6*d* net.

THIS book is scarcely the philosophical treatise which its title may suggest. It is the written-up version of six lectures on probability and applications, as conceived from von Mises' special pragmatic and empirical point of view. The lectures, to each of which a chapter is devoted, are couched in popular and non-mathematical style, but have none of the faults of this style. The English translation is excellent.

Dr. von Mises is well known as a strong protagonist of the relative frequency theory of probability. Probability to him is the limit of relative frequency in an indefinitely continued sequence of trials, but the sequence must be random. Imagine a coin spun repeatedly; write 1 for heads, 0 for tails. Then, according to von Mises, if in n spins m 1's appear, the probability p of heads for this coin is the limit of m/n as n tends to infinity; but he postulates not only the existence of this limit, but also the important additional property, that if any infinite subsequence be lifted out of the parent sequence on the basis of position only, irrespective of whether 1 or 0 appears in that position, then that subsequence shall have the same limit p as before.

Much of the earlier part of the book develops in simple language this theory of random sequences, and compares and contrasts it with the classical theory of probability. The later chapters pass, rather more summarily, to such topics as the so-called 'law of large numbers', kinetic theory of gases, the quantum theory, statistics and causality and the principle of uncertainty. This is all interesting, and done with an original turn, but the mind of the reader keeps reverting, with sympathetic scepticism, to the original attempt to define randomness. How can the postulate of place selection be expressed in mathematical form? We may lay down particular subsequences, for example, those enumerated by the squares of the natural numbers, or by the prime numbers, and

so on. These are special place selections, and even for them it will surely be necessary to prove that parent sequences admitting such place selection actually exist The author assures us that A. H. Copeland and A. Wald have found satisfactory answers to such questions as these.

All the same, to the present reviewer, a von Mises sequence is merely a *sample* sequence, extended to infinity, for the coin or other object, and is only one of an aggregate of sample sequences characteristic of the object. A sample of what? There's the rub, we are brought back to the *a priori*. And why bar the door so strenuously to sequences other than the postulated random ones? Systematic sequences, for example, 010101 . . ., are imaginable, as well as sequences which, in respect of the same coin or object, may not have the same limit *p*. The desirable thing would be to deduce the sequences from *a priori* conditions, and to show that the exceptional ones, which we may, if we please, call non-random (though the concept of randomness becomes unnecessary), are of zero measure in the aggregate of possible sequences.

Such views, which are put forward here for what they are worth, are in no way intended to disparage the book, which is a most valuable addition, from any point of view, to the literature of statistics and probability. A. C. A.

DEVELOPMENT IN ETHIOPIA

Ethiopia
An Empire in the Making By Ferdinando Quaranta. Pp. xx+120+23 plates. (London: P. S. King and Son, Ltd., 1939.) 7*s*. 6*d*. net.

WE have to go back to the days of Rome for the mode of development inaugurated by Italy in its new Empire of Ethiopia. It started with road-making, on which at one time 60,000 Italians were employed, and already more than 3,000 miles of macadamized highways have been built out of 7,000 miles planned. At the same time the Italian scientific societies were mobilized to collect and tabulate the facts relating to earth, air and water. Lake Tana is stated to be of little importance to the Nile floods Alluvial gold was discovered and is now being worked, but there is no likelihood of rich reefs. Platinum seems possibly to be of more importance, and there was also discovered copper and iron ores, but no petroleum. The fauna and flora were surveyed in connexion with their adaptation to various altitudes and meteorological conditions.

Meantime, Castellani's wonderful health service of the war had been converted into a permanent organization for the country with a first-class research laboratory adapted to pathology and parasitology at Addis Ababa and hospitals in each of the four provinces which were created; about eight hundred qualified medical officers are employed. Surveying the collected facts, Italy granted twelve billion lire (£133 million) to be spread over some years for special development. Agricultural veterinary and forestry services were established with experimental stations in each province, these governed and manned by university-trained officers. In the civil administration we deduce that the method employed is an army to keep the peace, with specially trained civilians whose duty is mainly the development of the country. There is little information on the administration, but the education and health of the natives seem to be an especial care. Meantime large areas of land in the high plateaux were found derelict, much of it the former property of Ras Makonnen, and steps were taken to colonize it. Upwards of a thousand Italian families have been here settled, growing grain, coffee, cotton and a host of minor products. For some years this immigration may be almost indefinitely increased by the introduction of regular cultivation in place of the alternate clearing and fallowing of the land employed by the natives. To this end a commission is at work investigating titles to land so far as they exist.

The technique of the Italians throughout would seem to be that of a large business firm rather than the haphazard method usually adopted in British colonies, where development is in the first instance confined to what already exists, usually by the increased employment of the old methods. Scientific men are only called upon when some pest appears or there is a shortage of food, the basal facts required for their employ being still unknown. We can recall no instance where the State has boldly capitalized development and colonization, the great settlement hoped for in East Africa at the beginning of the century having degenerated into the formation of large ranches worked by native labour, a condition paralleled all the way south to the Cape. Here in Ethiopia, if success be ultimately achieved, may be seen the commencement of a planned "Dominion" rather than a "Colony", the successful result of which would be of profound world importance. J. S. G.

GEOLOGICAL RESEARCH IN CHINA

The Geology of China
By Prof. J S. Lee. Pp. xv + 528. (London: Thomas Murby and Co., 1939.) 30s. net.

THE remarkable growth of geological knowledge concerning China commenced with the foundation of the National Geological Survey, under the able directorship of the late V. K. Ting, in 1915. Its unbroken series of publications appeared in 1920 and those of the Geological Society of China in 1922. The first volume of A. W. Grabau's "Stratigraphy of China" was issued in 1924, the second in 1928, but invaluable as this exhaustive compendium was for a time, it soon became out of date as new results were accumulated, mainly by Chinese geologists whom Ting and his associates had trained. As the years passed, contributions rapidly increased, for provincial surveys, universities and foreign authors of many nationalities added their quota to the literature.

A new summary was overdue and it has been admirably accomplished by Prof. J. S Lee, himself a pioneer of the new movement. The book is not, as its title might indicate, a text-book of regional geology of the stereotyped kind: it is rather a collection of essays, planned on a common 'structural' basis, in which all the essential facts are incorporated and their significance exposed.

In the successive chapters of Part 1 the following topics are discussed: the natural physiographical units of China and adjoining territories; the rocks of its ancient floor; its marine transgressions with the succession of their sediments, their characteristic fossils and the chronology of their movements; the geotectonic aspects of the Cathaysian geosynclines and geanticlines, as well as the history of the east-west fold zones which interrupt them at regular intervals. Descriptions of certain types of shear-forms and of their influence upon the existing framework of eastern Asia follow. Studies such as these, continental in their scope, lead naturally to wider inquiries still, and Chapter viii contains an analysis of the facial traits of the earth as a whole, to which is added an exposition of the author's views on the origin of tectonic movements and marine transgressions in general. These, advanced in logical sequence and entering into controversial geodynamical problems, evade abridged treatment and are best considered as a whole. Certain notable conclusions, however, are briefly stated as follows:

"All tendencies to shearing movement on the continents are to be reduced to two components: the one towards the equator and the other towards the west. The latter is more pronounced in, if not restricted to, the low latitudes" (p. 351)

This, as the author admits, "sounds strikingly Wegnerian". Again:

"As a whole, then, the surface strain of the earth can be explained by an adequate increase of rotational speed" (p. 358); and

"The data thus assembled, when correlated with the 'pulsations' of A. W. Grabau . . . seem to favour the conclusion that it is the continued contraction of the earth that has caused the increase of its rotational speed" (p. 364).

These forcible speculations add value to and widen the appeal of the work as a whole, which still remains the only available, concise review of geological research in China as it stands to-day. Prof. Lee has succeeded in the extremely difficult task of condensing into comparatively little space a great amount of widely scattered stratigraphical and structural information, without sacrificing a lucid continuity of style for the sake of brevity.

Part 2 contains two chapters only, one of which is devoted to the contentious problem of China's Pleistocene climate. The other is headed "Regional Stratigraphy", and in it the larger stratigraphical units of fifty-one separate areas, ranging from Jehol and the Inshan Range in the north to Kuangsi and Kuangtung in the south, from South Manchuria and Chekiang in the east to Kansu and Yunnan in the west, are tabulated in natural successions with short lithological details and lists of leading fossils. How far the omission of subdivisions, and in rare cases of even larger units, is justifiable on grounds of simplification is a matter of opinion, but such arbitrary classifications are rarely entirely satisfactory. This one would have been improved by explanations of the origin of the terms and by the insertion of co-ordinates of the localities mentioned. As extensive tracts in China still await survey, modifications of the lists may be anticipated in future editions.

Each chapter is followed by its own selected bibliography, which would have been more serviceable had numerical references been given in the text and index. Illustrations total ninety-three items, including maps, sections and half-tones.

Geologists concerned with the great problems of continental movement will peruse the book with advantage; for students of Asiatic geology, whether their work or only their inclination leads to the East, it is an indispensable guide.

J. COGGIN BROWN.

ELECTRONIC MUSIC

By Dr. L. E. C. Hughes,
Imperial College of Science and Technology, London

BY electronic music is meant the electrical reproduction of musical tones through loud-speakers, the actuating currents either having a purely electrical origination, or, if arising from a musical source, depending essentially on electronic means for their control and amplification, thereby leaving the musical designer free to make experiments which are not limited by the necessity of making adequate acoustic power.

The most comprehensive developments have taken place in the United States of America, where Benjamin F. Miessner and Laurens Hammond lead the patent and commercial fields, and Lee de Forest demonstrated an electronic organ, one valve for each note, so far back as 1915. Germany, France, and Great Britain have also made important individual contributions, and the literature of the subject grows apace. This article is a brief review of the important electronic instruments available in Great Britain. The accompanying table gives the characteristics of a representative selection of such machines, without attempting to be exhaustive, because of the rapid developments in this field and the repeated introduction of new types. Those with novelty value do not compete among themselves, like the pianos. There is certain competition among the organs, since they have all been highly developed to meet a common need. Comparisons are difficult, since one cannot get them in pairs for a proper trial, but probably the time is coming when a scientific assessment of their qualities is due, which would settle many contentions among organists. Technically speaking, no one is quite certain what organists really want.

There are three major aspects of the problem, commercial, scientific and artistic. The commercial drive incites people to want something new or to do something already satisfactory in a cheaper or simpler way, for example, reducing the cost and bulk of pipe-organs, a lighter substitute for bells, or more noise from the feeble harpsichord. The

REPRESENTATIVE ELECTRONIC MUSICAL INSTRUMENTS

<table>
<tr><th>Type</th><th>Name</th><th colspan="2">Basic principle</th><th>Note operation</th><th>Special effects</th><th>Tone Registration</th></tr>
<tr><td rowspan="5">Novel</td><td>Thérémin</td><td colspan="2">Beat oscillator</td><td>Hand-adjustment</td><td>Glissando, Tremolo, Stop-button</td><td>None</td></tr>
<tr><td rowspan="2">Martenot</td><td colspan="2" rowspan="2">Beat oscillator and filters</td><td>Hand in ring</td><td>Glissando, Tremolo</td><td rowspan="2">Stop keys</td></tr>
<tr><td>Keyboard</td><td>Tremolo</td></tr>
<tr><td>Trautonium</td><td colspan="2">Neon relaxer with formants</td><td>Wire over plate</td><td>Glissando, Tremolo</td><td>Continuous stop knobs</td></tr>
<tr><td>Novachord*</td><td colspan="2">Valve oscillators with multivibrator division and filters</td><td>Keyboard (72 notes)</td><td>Mixed Tremolo, variable attack and decay</td><td>Dial stops, foot sustain</td></tr>
<tr><td rowspan="3">Piano</td><td>Miessner or Vierling</td><td rowspan="3">Hammer on strings</td><td>E-s pick-up</td><td rowspan="3">Piano keyboard (88 notes)</td><td>Swell and filters</td><td>Stop keys</td></tr>
<tr><td>Neo-Bechstein*</td><td>E-m pick-up</td><td>Swell</td><td>None</td></tr>
<tr><td>Pianotron*</td><td>E-s pick-up</td><td>Volume control only</td><td>None</td></tr>
<tr><td rowspan="5">Organ</td><td>Orgatron*</td><td colspan="2">Air-blown reeds, E-s pick-up</td><td rowspan="5">Manuals, pedals, swells, tremolos</td><td>—</td><td rowspan="5">Stop keys, pistons, and couplers</td></tr>
<tr><td>Coupleux</td><td colspan="2">Valve oscillators and filters</td><td>—</td></tr>
<tr><td>Hammond*</td><td colspan="2">E-m generators, synthetic</td><td>Variable stops</td></tr>
<tr><td>Midgley*</td><td colspan="2">E-s generators, synthetic</td><td>Variable stops</td></tr>
<tr><td>Electrone*</td><td colspan="2">E-s generators, synthetic</td><td>Synthetic bells</td></tr>
</table>

Instruments marked * are easily available in Great Britain and have been examined by the author. All instruments, except the Pianotron, have foot-swells; the organs, except the Hammond, have grand-swells also. In the Hammond, one stop only on each of the manuals and pedals can be drawn at a time. Specifications of organs can be varied over a wide range, according to requirements; the Hammond and the Novachord alone are mass-produced, and therefore invariable.
(E-m = electro-magnetic, E-s = electro-static)

scientific urge is to do these things in a new way, producing perhaps novel effects which may or may not have an eventual commercial value. The artistic aim in supporting these endeavours is to obtain new methods of expression and to compose for them, since composition in orthodox modes seems to be declining. The usage of an instrument depends on whether it is commercially satisfactory at the price, and on the sales drive to satisfy a manufactured demand.

The instruments mentioned have had some circulation and demonstration. The Electrone has been well received in cinemas and by the British Broadcasting Corporation, while the Hammond* has become best known. In the few years that the latter has been available, about four hundred models have been sold in Great Britain as compared with some six thousand in the United States, the production being fifty to sixty a week. Of the other organs, the Orgatron was used at the last Eisteddfod, and the Midgley* has just been launched. The Pianotron has recently appeared, made both by Everett and Chappell, and meets the modern need of conservation of space combined with concert-grand tone and volume. The latest instrument, the Novachord (a Hammond product), is so entirely novel, except its ordinary keyboard, that it will keep musicians of all grades amused for a long time. It is the sort of machine from which any keyboard enthusiast can get something worth while; it does not demand the discipline of the piano or regular organ.

The Novachord

Of the instruments offering novelty value many have been described, using a great variety of physical effects for generating and synthesizing desired or new musical tones. Valve oscillators, either pre-set or beating, have frequently been employed; also blocked-out wave-forms, either sinusoidal, chopped, or obtained from recordings of high-grade musical instruments, on spinning disks, scanned by light falling into a photo-electric cell, have been used.

The Novachord uses valves entirely, and in a new way. It is the second musical machine put out commercially by Hammond, and we are told there are more to come. It cannot replace any existing instrument, although it can imitate passably many familiar timbres. It has a 6-octave keyboard, above which is a row of stop-lever controls; for the feet there is a swell pedal, a duplicated sustaining pedal, and a bass sustaining pedal. The omission of the pedal clavier is a good selling point for non-organists. The keyboard manuals are not strictly percussive, as in a piano, but by setting the controls for a long build-up time, a very effective percussive touch is obtained, permitting, for example, a legato violin solo with a light harp-like accompaniment, passing through each other, if desired, on the one keyboard. The pedal sustains the weaker notes, without altering their loudness level.

The tones are obtained from twelve oscillators, the frequencies of which correspond to the top chromatic octave, the highest fundamental frequency being $E = 2637 \cdot 0$ ($A = 440$). The remaining fundamentals are derived from these twelve frequencies by division, one half in each of the five stages, each in a multivibrator dividing circuit, rather like those in television scanning circuits. Each fundamental has a control valve in which the output wave-form is adjusted, together with its attack and decay. The 72 notes, therefore, require 144 valves; some channel-amplifiers and power-packs bring the normal total to 159, double-triodes and small pentodes forming the majority. It is claimed that all valves, except the output stages, are lightly loaded and that the valve hazard is greatly diminished. The scheme for frequency-division seems logical, since the top frequencies cannot require much harmonic development; also the tuning operation on the top notes makes for precision over the whole range. Tuning is effected by adjusting the oscillators until one of the divided frequencies beats a known frequency with a known harmonic of the rectified mains.

The basic qualities of the Novachord are in the great range between percussive and singing, and in the adjustable attack. The tone-controls and filters, all adjustable over a wide range, are to some extent what one might expect, leading from a full diapason, reminiscent of a cathedral when fully delayed, to a thin reedy wood-wind of considerable power. Brassy and delicate tones are available, and the string tones are better than have been previously heard on a non-string instrument. A guitar effect is easily obtained, but, what is more interesting, good imitations of clavichord and harpsichord can be found, with, of course, ample volume; such possibilities may help to revive the interest in the older keyboard music, especially in public, which must have waned to some extent because of the lack of acoustic power and the difficulty of the cramped keyboards in authentic models.

A new feature in electronic music is not so much that three degrees of tremolo are here available, but that there are also six different rates, distributed in the twelve oscillators. The result is a delicate shimmer rather than the usual throb or wobble, recalling *tutti* violins; perhaps this is an effect organists are seeking; they never seem

* Descriptions of the Hammond and the Midgley organs appear in a paper recently issued by the Institution of Electrical Engineers, to be printed later in the Institution's *Journal*, entitled "Electronic Musical Instruments and the Development of the Pipeless Organ", by G. T. Winch and A. M. Midgley.

certain whether they require amplitude or frequency modulation, or both.

In construction, the Novachord has novel features. The whole of the valve system, couplers, filters, etc., is built into an enormous chassis, which can be turned over for servicing; electrical connexions to the keyboard are taken through long springs, so that the valve system need not be made dead during adjustments.

Finally, it may be remarked that there is no synthesis of notes on an equi-tempered scale involving borrowed quasi-harmonics, as in some electronic organs This may please regular organists, because the non-coincident harmonics of the notes of a chord beat against each other in the customary way, and are not resolved into a perfect series of overtones, which is apparently one of the things conservative organists do not like, however pure it may be declared to be We refrain from attempting to define what a pure tone, in the musician's sense, is supposed to be

New Pianos

The difficulties of imitating a piano are great, the initial impulse and the dither being awkward from the electronic point of view A negative time-constant of attack has been achieved in the Novachord and this may lead to a complete electronic piano. The electrical amplification of piano tones is of long standing, but the usage has been slight; the recent arrival of the Pianotron may change this.

It is an easy matter to apply either electromagnetic or electrostatic pick-ups to the strings of the piano, and to control the output currents in volume and tone; the mistake which seems to have been made is to try to get something new out of hitting a stretched string with a felt hammer. It is true that tone amplification permits less tension in lighter strings and the elimination of the sounding board, with consequent lighter frames and extremely long time of decay, due to reduced damping. In the Neo-Bechstein, the middle forty notes alone have double strings, the remainder are single. This results in a steel-string tone, substantially undamped when sustained, with great range of crescendo and diminuendo on the swell pedal. Supposing that one wants real steel-string tone, very great care is necessary to avoid considerable blur. This instrument uses electromagnetic pick-ups, one for each set of four strings, located near the ends of the strings remote from the hammer. In the Vierling Electrochord there are a number of pick-ups along the wire, so that some of the sustained overtones are not lost.

Whereas in the Neo-Bechstein the piano has been simplified, in the latest Pianotron, where only straight amplification with electrostatic pick-ups is attempted, it has been found that it is essential to take the greatest care in the construction of the complete small piano, otherwise defects in the tone production are magnified. The electrostatic pick-ups are merely adjusted screws, ranged on a shaped board, which can be fitted into any ordinary piano: screening to some extent is essential, but the scheme permits concert-grand volume in the smallest space at a very reasonable cost. Many novelties may come and go, but the attractions of the dynamics of the free felt hammer on trichords will remain for those who wish to attain to them.

Pipeless Organs

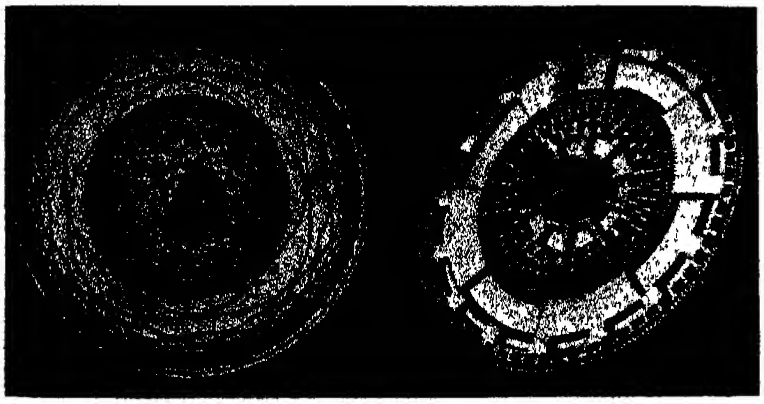
The dictionary definition of an organ must now be curtailed by the omission of any reference to pipes blown by air, for clearly an instrument which is played like an organ and sounds like an organ is certainly an organ, in spite of the purists. The wide variety of wave-forms obtainable from a valve oscillator has induced inventors to synthesize and control tones for organ purposes in diverse ways; the more recent successful instruments, however, do not use valves at all, except for amplification.

The Orgatron is most near a regular organ; indeed, it is a five-rank instrument, entirely pneumatically controlled, with air-blown free reeds, the motions of which are amplified through electrostatic screw pick-ups. The scheme is rather like that of the Pianotron, except that the polarizing voltages are not constant but are applied to the ranks as required by the stop keys. Fundamentally, when a key is depressed, high-pressure air is passed into the tube mechanism and eventually allows low-pressure air to pass through all reeds brought in by the pneumatic action of the stops. The stops also charge the pick-up screws to pre-set potentials through resistance-capacity retarders (to obviate key clicks). The fluctuating potentials on the screws, arising from the motion of the reed and consequent change in capacitance, are applied rank by rank, all the rank screws being in parallel, to the relative amplifier, after which they are mixed by anode-coupling.

Thus there is no synthesis of tones in the electronic sense. The five ranks of reeds, of which there are 289 in all, are voiced and tuned by the usual manipulation of the languids, and fundamentally give celeste, melodia, diapason, viole, and a pedal tone. From these a good selection of registrations is possible, augmented by a synthetic oboe and quintadena. Actual tubular chimes can be operated by second touch on the great, and an echo-radiating unit helps with reverberation in damped surroundings. Tremolo arises from a motor-driven paddle in front of the loud-speakers.

In appearance, the Orgatron is similar to most other two-manual organ consoles.

The Hammond organ has previously been described in these pages (NATURE, June 19, 1937, p. 1043), and was shown by Sir James Jeans recently at the Royal Institution. The original model has been brought into conformity with the requirements of the Royal College of Organists for non-secular purposes by curving and adding a few notes to the pedal clavier, by having independent swells for the two manuals, and replacing the manual stop keys by pistons. Readers will remember that tones are synthesized from 96 inductor generators on two shafts driven by a synchronous motor, a number of adjustable stops for experimentation being provided.



THE COMPTON ELECTRO-STATIC FREQUENCY GENERATOR.

Left, one of the stators, showing the electrified tracks between anti-phase sine-wave insulating ridges, the remaining spaces being earthed, right, the rotor, which scans all the tracks and couples the modulated potential to the grid of the amplifier via the ball-bearing contact at the end of the shaft.

Scientifically, the Electrone and the Midgley are very similar. Each uses electrostatic runners, the periodic change in capacitance modulating the potential steadily applied through a resistance. In the Electrone there are twelve generator units, corresponding to the lowest chromatic scale, driven by one continuous belt from a synchronous motor. In the generator unit the scanner is connected, together with the eleven others, to the grid of the first amplifying stage. The radial scanning blocks, one per wave-length, are embossed so as to oppose double sine-wave tracks with earthed separations.

It is evident that all the harmonics of a bass-note can be obtained from one unit, since there is no fundamental difficulty in cutting tracks of an increasing number of wave-lengths. The total number of tracks is, however, markedly reduced by borrowing. For example, on the natural scale the G-wheel has a speed 1·5 times that of the C-wheel, all the units being the same, except for speed. Therefore the 3rd harmonic of C coincides with the 2nd harmonic of G; so why not use the 2nd harmonic track on the G-wheel when the 3rd harmonic of the C-wheel is required, thus dispensing with the 3rd harmonic track on the C-wheel, and so on, yielding a great economy in tracks? The driving wheels, however, are so diametered that the fundamentals and the harmonic tracks are equi-tempered. This makes the G-wheel about 0·1 per cent slow on the C-wheel. The third (borrowed) harmonic of C is therefore a little out of tune, a fact which is easily noticed on a cathode-ray tube, but it is doubtful if any organist can have noticed it by ear. Again, when C and G are sounded together, either on the keys or as a synthetic stop, the third harmonic of C does exactly coincide with the second of G, since it is borrowed, the increased magnitude of the common frequency being provided for in the electrical circuits. This means that the beat which ought, on the equi-tempered scale, to be present between the third harmonic of C and the second harmonic of G, amounting to about 0·1 per cent of the nominal common frequency, is not there. This argument can be greatly extended, the absent beats between some harmonics being more pronounced than that above indicated. The Electrone compromises in that only the third harmonics are borrowed.

There is no doubt that the scheme works and the machine sounds very much like a regular organ, but is it this absence of beats among harmonics which prevents the more precious and conservative of organists from admitting that the Electrone is an adequate substitute, at a third the cost, for a regular pipe-organ? Can any ears be so sensitive in a live room?

The Midgley electronic organ functions in a very similar way, except that in the unit generator the dielectric alone rotates The sine-wave areas on the stator electrodes oppose the blocks of the scanning dielectric as before The notes are synthesized as required by the stops in the electrical circuits as before; registering a number of stops builds up the contributions, just as extra ranks of pipes are ordinarily brought into action. Corresponding in function to the draw-bars in the Hammond, sets of dials are provided for players to experiment with in using new stops or doubling existing stops.

It can be fairly claimed that these electronic organs function as intended, but whether one is

superior to the others for a specified musical purpose is an open question and must await a proper series of trials, with adjudication by a representative body of musicians; meanwhile, those who have to pay for organs are deciding for themselves.

Accepting the musical adequacy of electronic organs, their use in churches has several artistic and technical advantages The disposition of the sound radiators permits a fine unanimity of attack in congregational singing. Acoustical treatment to enable preachers to be heard need not spoil reverberation, which can be increased artificially to any degree desired. Finally, the great enemy of pipe-organs, cold weekdays and a warm Sunday, is rendered innocuous: electronic organs scarcely need tuning.

The craft of the organ tuner, with his mallet and cones, has started to pass; he is being replaced by an electrician, with no more equipment than is required for servicing a radio-set. There is one thing we can be certain of, no electronic organ ought to succeed unless it is finally voiced by a craftsman of tradition. If this is not insisted on, classical organ tone will not be known to the rising generation, brought up on secondhand and harsher music, and may be lost for ever.

APPLICATIONS OF PSYCHOLOGY IN WAR CONDITIONS

A SYMPOSIUM on some applications of psychology in war conditions was arranged by the Industrial Section of the British Psychological Society and held on January 25 The introductory paper was by Dr. May Smith, who gave an outline of the final report of the Health of Munition Workers Committee, published in 1918, and addressed to the Right Hon. Winston S. Churchill, M.P., then Minister of Munitions. The Committee included Sir George Newman, Sir Walter Fletcher, Sir Leonard Hill, representatives of the Home Office, members of Parliament, physiologists and pathologists. It had been appointed in September 1915 "to consider and advise on questions of industrial fatigue, hours of labour, and other matters affecting the personal health and efficiency of workers in munition factories and workshops".

At the beginning, the Committee was confronted with the width and complexity of its inquiry. The central and foremost problem was concerned with fatigue Having realized that continuous human activity is associated with a gradually diminishing capacity, the Committee decided that the only direct test was that of output.

Views on the more theoretical aspects of fatigue were really immaterial, since it was known that the ordinary restrictions on hours of labour had been very widely relaxed, that Sunday labour previously forbidden for women and young persons and practically unknown for men, except for a few continuous processes, had become common The employment of men for 70–90 hours a week was common, more than 90 hours was not infrequent, and there were even cases in excess of 100 hours. In short, there was a return to some of the worst conditions of the early nineteenth century.

The Committee used two methods of getting information: (1) it took evidence from people in direct contact with workers, (2) it initiated *ad hoc* investigations. The first method enabled it to get information at once, the other necessitated time.

On reading through the evidence, it is impossible not to be struck by the volume and pertinence of the findings. On the whole, the evidence showed that long hours imposed too severe a strain on the workers, with the result that the rate of production tended to decrease, sickness absence and broken time to increase. Evidence of the almost intolerable strain on the management was given. The full blast of the hours was not felt at first, because the increased pay resulted in better food.

Such evidence, while overwhelming in some cases, was, however, not quantitative, and witnesses differed widely as to what constituted reasonable limits; the Committee had to emphasize the almost complete absence of any scientific data.

The appointment of Dr. H. M. Vernon and others was intended to supply this deficiency. He showed by output figures that the 12-hour day was a costly and useless procedure, that the long hours simply defeated their own end. "The country cannot afford the extravagance of paying for work done during incapacity from fatigue just because so many hours have been spent upon it," reported the Committee.

Apart from hours, environmental conditions were realized as important, and ventilation emerged out of the hands of the engineers and passed to those of the physiologist, and under the ægis of Sir Leonard Hill there entered the katathermometer.

Lost time through sickness absence, lateness, broken periods, or just absence, soon became a formidable problem. The causes of lost time were classified into two main groups : (a) Causes mainly inherent ; for example, the employment of people of inferior physique, inadequate housing and transport facilities, wintry weather, darkened streets and inequalities of food supply, the domestic duties of married women, the war-preoccupation and exigencies of all workers, sickness and disease caused by conditions outside the factory. (b) Causes mainly controllable ; for example, fatigue, sickness and accidents of factory origin, insufficient wage incentive, faulty internal organization, indifference, slackness, laziness, discontent, prolonged hours, overtime, insufficient rest periods or holidays, and excessive consumption of alcoholic beverages.

The Committee came to the conclusion that the absence through sickness was considerably underestimated, and pointed out that if there is an undue proportion of sickness in any group of workers there is also likely to be lessened vigour and activity among those who are not away sick. It noted the absence of adequate records, partly due to difficulty in regard to medical certificates and partly because minor illnesses were not reported

The section on incentives starts off, not with wages or bonuses, but with the statement that "the first incentive is the health and physical fitness of the worker", and although the Committee confined itself to the factory conditions contributing to that, yet the field covered is very wide. Only after this does the Committee discuss wages, which must be "well adjusted, equitable and clearly understood".

The Committee notes that "what is needed is not a cast-iron system of employment but a sympathetic or correct understanding of the physical and mental capacities of each worker and their most satisfactory and economical application".

The present War has introduced many of the conditions of the War of 1914–18, but already after four months there are signs of an interest not aroused until after thirteen months before ; happily we are better equipped now than in 1914.

Dr. Vernon took up the discussion, pointing out that excessive hours constitute a major problem when increased output is urgent. Many employers cannot grasp the fact that, after a certain number of hours of work, the worker is so fatigued that production falls. Some investigations undertaken during the War of 1914–18 showed that the actual gross output—not merely the average hourly output—is less on a 12-hour day than on a 10-hour. It is true that in the early stages of a war, patriotism plays a definite part in keeping up the output, and in the last War employers often defended the excessive hours on these grounds ; but Nature cannot be defied indefinitely and many men and women were in a chronic state of fatigue. For many processes in munition work, Dr. Vernon found that output is a very satisfactory measure of the effects of hours of work, since the same materials are being used and the same articles made, the only important variable being the number of hours worked. Sunday labour, except for emergencies, proved wholly unsatisfactory, in spite of the extra pay · it has been described as "8 days' pay for 7 days' work with 6 days' output".

The problems involved in night-shift work are not easy to solve, for, quite apart from the organization within the factory, there are complications connected with the domestic arrangements of the workers and transport

With regard to the material environment, Dr. Bedford pointed out that there is now available considerably more scientific knowledge than in 1914. Numbers of researches have been made to find out the relationship of lighting, heating and ventilation conditions to efficiency, comfort, accidents, and health The last twenty-five years have shown a pronounced tendency to have more light, not only for fine work but also in general : a good light is felt to be more cheerful. Working all day in artificial light gives people a feeling of being cheated ; if, however, owing to the nature of the work, this is inevitable, much can be done by the use of extended light services and by arranging artificial windows and similar devices.

Heating and ventilation cannot be kept separate. It used to be considered adequate if the air was pure and stimulating . now increased emphasis is laid on the need for an adequate degree of warmth as well. As with lighting, the standard of warmth has gone up , many factories used to be below 50° F , whereas recently a research worker experienced difficulty in finding one below 55°. For the full assessment of thermal conditions a single yardstick, however, is impossible ; individual conditions have to be considered and weighed.

The recent 'black-out' regulations have added to the difficulties of factories relying on open windows, so that there are many complaints of stuffiness and overheating. Forms of light-traps, however can be devised, which allow of the entrance and exit of air while complying with the lighting regulations.

Dr. Millais Culpin said that since 1914 considerable progress has been made both in the diagnosis and treatment of psycho-neurotic illness. The last War took us unawares, with few doctors capable of treating such illness or even of recognizing its existence. Psychological casualties in the civilian population under direct war risk may be

fewer than we might expect, for the civilian is allowed to show manifest fear or to run away. That some kinds of psychoneurotic people should retire to the West Country—as many did during 1914–18—is best for everybody. He regretted the use of a phrase now rather popular, namely, 'fright neurosis'. Fear is of biological significance, and to be afraid, even greatly afraid, is, in some conditions, a natural reaction. Pathological fear is in a very different category, the reaction being usually quite inadequate to the situation.

Nor is it right to class all psychoneurotics in one group; some of them can be diagnosed as likely to break down in peace or war, and some will not; others will withstand the most difficult conditions. Some who had managed to adjust themselves to the last War and to the years since have broken down now, suppressed memories of the last War being touched up. To confuse such cases with 'fright neurosis' is disastrous.

How civilians will behave in air raids is difficult to predict. It is possible that some with a high degree of claustrophobia will prefer to be bombed rather than have the feeling of being in an enclosed space; within a shelter some may faint, and others may adjust to the circumstances although feeling considerable discomfort. With regard to the question of what can be done with cases of uncontrolled behaviour or of those who faint in an air-raid shelter, Dr. Culpin said that the fainting neurotic might be left to himself, while harsh treatment might be needed for others. Two schools exist in the medical profession with regard to the treatment of the neurotic who has broken down: one is the school which would diagnose and treat by psychological means, and the other he called the 'kick in the pants' school. Fortunately for the world, the latter is found chiefly among the elderly, who are despised by the younger and more adequately trained doctors.

Mr. Alec Rodger, discussing the selection and grading of personnel, said that a great stimulus to this was provided by the Americans in the War of 1914–18. In order to sort out people fit for different kinds of training, nearly two million men were given intelligence tests. The experiment proved so successful that other countries, including Germany and the U.S.S.R., have adopted similar intelligence testing procedures. Mechanical aptitude tests have also been widely employed. Both intelligence and mechanical aptitude tests and other psychological techniques are used to a limited extent in our own fighting Services.

The value of tests in the grading of personnel needs special emphasis. Many are accustomed to think of them only as instruments in the selection of men and overlook the fact that they can be used effectively in the grading process, the aim of which is to arrange that individuals of similar abilities are instructed together. Mr. Rodger added that, since intelligence tests had been used by many school and other authorities over a period of years, much data of value to the Services could probably be made available immediately.

CENTRAL REGISTER OF SPECIALISTS

(SECTION FOR SCIENTIFIC RESEARCH)

IN the issue of NATURE of April 8, 1939, p. 575, there was an account of the establishment by the Royal Society and the Ministry of Labour jointly of the Central Register of Specialists (Section for Scientific Research), with the main aim of providing a list of scientific workers whose professional services might be useful in time of war. It will be remembered that each scientific worker was asked to fill in a card giving an account of his qualifications and some details of his career. From the point of view of the Royal Society the register also had a secondary purpose, for, if there were not to be a war, then it was felt that this was a good opportunity to obtain a census of the scientific knowledge of the country which would be of general value. With the outbreak of war the main purpose of the register was called into play, even before its compilation was complete, and it will be of interest to give a short account of some of its consequent workings. This article only deals with the register of men of science, and does not touch on the similar work of the Ministry of Labour in other branches of learning or technology.

In the spring of 1939, cards were sent out to men and women whose names had been furnished by certain learned societies. Up to the end of July a little short of eight thousand had been sent out and some five thousand replies received. Since July, several hundred more have been sent out to people who had been missed in the earlier lists, and the total number of cards returned is now more than six thousand. This list is largely composed of names from universities, from industries and from the research associations. Men already in the Government service have also been permitted to send in their cards, so that they are

included in the census; though of course their services are already at the disposal of the Government, so that for them the more immediate function of the register does not arise. The committee of men of science which is helping to work the register is subdivided into panels composed of experts in each subject, and during the summer the panels met to sort out and classify their cards. There are, of course, great differences in the characters of the various subjects, and there was great uncertainty in the natures of the expected demands, and so no uniformity was attempted in the practice of the different panels. For example, the engineers and physicists subdivided their list into quite small groups, whereas in mathematics it was inappropriate to do this because, apart from the leading experts in each branch whose names would be well known, general mathematical skill is easily transferable from one subject to another.

On the outbreak of the War, the register immediately began to function. A certain number of leading men of science had already been earmarked for service directly, so that it was for junior posts that the register was specially useful. Recourse to the register is now the normal procedure for filling all scientific posts in the Government service when these are of the standard of the register. The way the register operates is usually somewhat as follows. The Government department requiring staff presents a written demand to the register for the staff that is needed in order to fill a certain number of posts, stating the nature of work, the qualifications required and the salary offered. A preliminary selection from the cards in the register is made by the staff of the Ministry of Labour with the advice and assistance of the expert panels, and often of technical representatives of the departments. The selection is then submitted to the appropriate panel so that the selections can be considered, and if necessary discussed with a technical representative of the ordering department. In this way the quality of the man needed can be more accurately assessed. When a final selection has been made, the men selected are circularized and are asked whether they are willing to be considered for the post offered provided that their employers are willing to release them. Thus the department concerned receives from the register what is practically a short list of suitable candidates who are known to be willing to take the post offered. The department then itself arranges for interviews and makes the appointments, and the Ministry of Labour takes no further part in the proceedings, except to record appointments.

It may be appropriate here to refer to a matter which has received some attention though it is not directly connected with the register. In many laboratories a number of men are doing co-operative research, and it was felt that the operation of the register, which deals with individuals, might seriously endanger such work by taking away some members, possibly even though they might be only minor members, of such teams. The question of safeguarding scientific teams was entrusted to the Department of Scientific and Industrial Research. The matter proved by no means easy, because a team is a very indefinite thing. For example, in one university a laboratory might with equal justice be regarded as either one or several teams, while in another, with quite as good a scientific record, the work of the members would be so independent that it would hamper their usefulness to call them a team at all. In the end it was settled that (with one or two special exceptions) there were to be no teams in universities, since if the operation of the register was in danger of spoiling important team work it would be easy for the university or the head of a department to make (as 'employer') representations to that effect On the other hand, there was danger that the production of industry might be seriously hampered by draining away the members of its research teams, and so the research laboratories of a number of firms have been registered as teams. Their members cannot be called on through the machinery of the register without consultation with the Department of Scientific and Industrial Research.

The register has now been working for more than four months and it is possible to review some of its results. It appears that it has well justified the effort put into its preparation. For the most important appointments it was of course scarcely necessary, as the likely candidates for such appointments would be familiar to any adviser, but for other appointments it has been most useful, so that wherever a need has arisen in the Services, names could be put forward to meet it. In some of the subjects the demand has exceeded the supply, but there are a good many where the opposite is the case. As might be expected, the biological subjects are not in great demand for matters connected with the Services, and few new outlets for them are apparent in agriculture or industry; it looks unlikely that, for example, there will ever be calls for more than a limited number of zoologists or botanists as such. On the other hand, certain categories have become practically exhausted of scientific men. The question of training people for rare categories is being examined, and persons with 'secondary' qualifications in them are used when possible.

Consideration has been given to the point that it is now possible to say that a good many of those on the register who are reserved under the Schedule

of Reserved Occupations will probably never be called on to use their professional knowledge for war purposes in a civil capacity, and the possibility has been examined of notifying them that they are released from their reservation It was felt that it would be very invidious to take the initiative in this, but machinery has been set going to arrange for the possibility of release It will be open to any scientific man reserved under the Schedule to apply for release, and his case will be considered by the appropriate panel. In arriving at its decision, the panel will give consideration to any representation by the applicant's employer (university, firm, etc.), and to the possibility that the applicant's professional services might be needed later, even though the demand is not yet apparent In view of the differences of demand in the various scientific subjects, each panel is adopting its own policy, but broadly speaking the general policy will be that release will be granted to anyone who is unemployed or likely to become so, while for others the grant will only be made after much more careful consideration of each application.

OBITUARIES

Sir Francis Goodenough, C.B.E.

SIR FRANCIS GOODENOUGH died on January 11, after a long period of ill-health, at the age of sixty-seven. It is possible to surmise that had he come under the influence of a science master at an impressionable age, as has happened to many of us, he would have made a career in some branch of science which would have gained a great leader. As it was he performed what is perhaps the more difficult feat, namely, the introduction of some measure of planning and science into commerce.

He lived to see the subject of management adorned by the adjective 'scientific' and to participate in international congresses under the double heading. He was one of the first and greatest salesmen in the gas industry, where he emphasized the importance of supplying a service as well as a commodity Equally valuable were his services in the cause of education applied to gas engineers and gas salesmen. Here he insisted that the scheme, elaborated in conjunction with the City and Guilds of London Institute, should be one of education as distinct from examination only It is known that the early difficulties in connexion with this were almost overwhelming, and that but for his patience it would have been difficult to overcome them

Sir Francis was a pioneer of co-operative advertising and a leader of many other co-operative movements both within and without the gas industry. A man of rare vision and large ideas, faculties usually involving impatience, he was characterized by an easy and genial manner and the quality of complete sincerity. In addition to his successful career with the Gas Light and Coke Company, which he saw rise from something very much smaller to its present outstanding position, he was always visualizing developments ahead of the time.

Sir Francis was one of those who will probably appear greater in retrospect than he does at the time of his activities, when personalities and policies hold the stage. Science and commerce lie perhaps on opposite sides of the river of daily endeavour, but many bridges are being built across the river, over which traffic struggles in either direction. One such bridge builder was Goodenough; the edifice he has erected, built on sound foundations, will stand the stresses of stream and wind and the increasing load of progress for many years to come E. F. ARMSTRONG.

Miss E. K. Pearce

MISS ETHEL KATHERINE PEARCE, whose death occurred on January 8, at Morden, Dorset, at the age of eighty-three, was an entomologist who devoted her energy and enthusiasm almost entirely to Diptera. A daughter of a vicar of Morden, she had around her one of the finest entomological hunting grounds even in a county as favoured as Dorset. The first series of her work, "Typical Flies", a photographic atlas in which the author sought to popularize and extend the study of an order of insects much neglected in those days, was published in 1915. A preface giving practical guidance for collecting and preservation is followed by a sketch of Brauer's classification of the Diptera, and his sixty families are named, the Aphaniptera (fleas) being included. The forty-five pages of reproductions from photographs, considering the great difficulty of such work, are admirable, the flies figured being all recognizable and characteristic. In some cases preliminary stages are shown. The photographs of typical Dorset localities are a very pleasing and helpful feature. They not only give information as to the habitat of the fly, but also tempt the Nature lover to explore such delightful environment.

The flies taken as types of the various families were chosen with the help of the late Prof. Theobald, F. C. Adams, and other capable authorities, with great care. A second series appeared with 125 photographs in 1921, and a third series with 162 photographs in 1928. In all, fifty-five out of the sixty families of flies enumerated by Brauer are represented in the three series by a type fly. The brief biological notes given under the figures add much to the interest of the book. The author was helped, too, in her work by her brother, Mr. N. D. R. Pearce.

Amiable and benevolent, and ever keen on doing useful work, Miss Pearce's death leaves the ranks of entomology the poorer. Her contribution cannot fail to aid beginners in classifying and identifying the flies they find. Non-specialists, also, who wish to place any fly they see in its systematic position, will likewise find Miss Pearce's guide a boon.

F. H. HAINES.

WE regret to announce the following deaths:

Prof. Aristide Busi, director of the Institute of Medical Radiology, Rome, aged sixty-five years.

Mr. W. M. Gardner, principal of Bradford Technical College during 1905–21, on December 22, aged seventy-eight years.

Mr. W. H. Lovegrove, formerly conservator of forests, Kashmir, on January 25, aged seventy-two years.

Prof. Ugo Mondello, the well-known seismologist, formerly director of the Ardenza Observatory, Italy, on December 3, aged sixty-one years.

Prof. S. Lees, Chance professor of mechanical engineering in the University of Birmingham, aged fifty-four years.

Mr. B. D. Porritt, director of research of the Research Association of Rubber Manufacturers, on January 28, aged fifty-six years.

Mr. F. T. Shutt, C.B.E., formerly Chief Dominion Chemist and assistant director of the Central Experimental Farm, aged eighty years.

Prof. C. A. Strong, formerly professor of psychology in Columbia University, aged seventy-six years.

NEWS AND VIEWS

Scientific Collaboration between Britain and France

A DELEGATION from the Centre National de la Recherche Scientifique, led by its director, Prof. H. Longchambon, has been visiting Great Britain during the past week. The other members of the delegation were: Prof. M. Fréchet, professor of mathematics at the Sorbonne; Prof. G. Darmois, professor of mathematics at the Sorbonne; Prof. F. Joliot, professor of physics at the Sorbonne; Prof. P. Auger, professor of physical chemistry at the Sorbonne; Prof. C. Sadron, professor of building legislation at the Ecole Nationale Supérieure des Beaux-Arts, Strasbourg; Prof. G. Dupont, professor of theoretical chemistry at the Sorbonne; Prof. Denivelle, professor of chemistry at the Ecole Supérieure de Chimie at Mulhouse; Prof. A. Mayer, professor of medicine at the Collège de France; Prof. L. Blaringhem, professor of botany at the Sorbonne; Prof. P. Chouard, professor of agriculture at the Conservatoire National des Arts et Métiers; Prof. P. Langevin, professor of experimental physics at the Collège de France; Dr. P. Montel, professor of mathematics at the Sorbonne. This, it may be presumed, is one of the measures referred to by Lord Chatfield when he spoke recently in the House of Lords on the exchange of information and extension of the liaison between the scientific organizations of Great Britain and France (see NATURE, Jan. 27, p. 142).

The programme arranged for the visitors included a reception at the Royal Society on January 29, when the guests were received by Sir Albert Seward and Prof. F. G. Donnan on behalf of the Royal Society. Dr. E. V. Appleton then addressed the meeting, and described the organization of the scientific effort for defence in Great Britain. The French delegation was introduced by Dr. Montel, after which Prof. Longchambon described the steps taken in France to mobilize scientific research for the country's war effort. Prof. Langevin also spoke. On January 30, the French delegation visited the National Physical Laboratory at Teddington, and on the following day travelled to Cambridge, where they saw the Cavendish Laboratory (Prof. W. L. Bragg) and the Colloid Science Laboratory (Prof. E. K. Rideal). A meeting of the Royal Society was arranged for February 1, at which Sir Arthur Eddington was reading a paper on "The Masses of the Proton, Neutron, and Mesotron", and L. Jánossy and B. Rossi a paper on "Photon Component of Cosmic Radiation". Prof. E. J. Williams was giving an account of his experiments on the transformation of mesotrons into electrons (see NATURE, Jan. 20, p. 102), and Prof. P. Auger and Prof. P. M. S. Blackett were taking part in the discussion. On the same evening the French delegation were being entertained to dinner by British men of science.

Scientific Research for the Services

THE Advisory Council of Scientific Research and Technical Development (see NATURE, December 30, 1939, p. 1085) held its first meeting at the Ministry of Supply on January 25. Colonel J. J. Llewellin, in the absence of the Minister of Supply through illness, pointed out the Ministry has numerous establishments for research and development, etc., which, in some directions, work for all three Services: these establishments are supplemented by work in progress at various other research laboratories throughout the country. Lord Cadman, chairman of the Council, said that the research programme is most extensive, comprising more than a thousand items. The subjects being dealt with vary within very wide limits; it is therefore necessary to have an extensive and comprehensive scientific representation on the Council, which will function through a number of committees, on which other men of science will be invited to serve. So far, the committees formed deal with metallurgy, general physics, ballistics, structural engineering, communications, etc. The Directorate of Scientific Research of the Ministry of Supply

already has a permanent staff of about nine hundred, but it is satisfactory to know that the Council also proposes to enlist the aid of independent outside men of science if, and when, required.

Institution of Electrical Engineers: Faraday Medal

DR. ALEXANDER RUSSELL has been awarded the eighteenth Faraday Medal by the Council of the Institution of Electrical Engineers. The medal is awarded for notable achievement in, or help to, electrical science or industry, and Dr. Russell is qualified in both respects. His works on alternating currents and the theory of cables have long been classical; not less well known are his researches on the sphere gap, and many other mathematical researches and papers communicated to the learned societies. He recently published the "Life of Lord Kelvin", whom he knew in the early days. Dr. Russell has been connected with Faraday House from its inception in 1889, and became principal in 1909. During fifty years he has helped in, or been responsible for, the training of thousands of electrical engineers, now to be found all over the world. The outstanding feature of this education has been the encouragement of men to bear their own responsibilities; many of his students, both in the early days and recently, have achieved important work even during their student days. He has been for many years a valued contributor to NATURE.

Dr. Russell is a past president of the Institution of Electrical Engineers, of the Physical Society of London, and of the Junior Institution of Engineers. He was elected fellow of the Royal Society in 1924 and made an honorary member of the Institution of Electrical Engineers in 1937. Later in the same year he retired from the more active work at Faraday House and became advisory principal. He thus holds available for the College his life's experience, and maintains contact with the hundreds of old students who can call in to see him, and with the thousands who can only write. We like to think that it is this aspect of his life's work, and the army of valuable men that has resulted from it, that the Council of the Institution of Electrical Engineers had in mind, not less than his mathematical researches, when the award of this year's Faraday Medal was made.

Captain C. W. Hume

CAPTAIN C. W. HUME resigned from the editorship of the *Proceedings of the Physical Society* on January 1, after having been responsible for that journal for a period of twenty years. A member of the reserve of Army officers, he rejoined his unit some time previously, and continued his editorial work until impending changes made it no longer possible. During his tenure of the office, he had seldom missed a Council meeting, and was usually present at science meetings, to obtain a record of the discussion on papers at first hand. He took great pains with the preparation of the *Proceedings* to ensure that papers should be free from ambiguity and obscurity, and printed in uniform style. His other interests were many. He founded the University of London Animal Welfare Society and the Universities Federation for Animal Welfare, and had also taken an active part at one time in the Association of Scientific Workers and the Parliamentary Science Committee, as it then was.

African Studies and the War

NOTWITHSTANDING the War, native administration in Africa must be carried on; and the problems incidental thereto are likely to become more, rather than less, insistent in the world turmoil which now prevails. For the moment, indeed, paradoxical as it may seem, circumstances probably are more favourable to African studies directed to possibilities of future development than if the end of hostilities were within measurable distance. Such, at least, would appear to be the judgment of H.M. Secretary of State for the Colonies, at whose request Lord Hailey will shortly pay a visit to a number of the British dependencies in West, East, and Central Africa to undertake an informal study of certain aspects of native administration. This investigation will carry further the work on such questions which Lord Hailey has already done during his earlier visits, when collecting material for his "African Survey". His inquiries on this occasion, which are expected to take about six months, will be directed in the main to the comparative study of forms of native administration, with special reference to their technical working and their future development. It will be of more than passing interest to see how in the judgment of so experienced an observer as Lord Hailey the diversity of conditions which will be brought under notice justify, or the reverse, the standardization of administrative methods in the interests of native advancement, and how far a more intensive study of native institutions in relation to administration than they have yet received, is demanded.

At the close of his tour, Lord Hailey will spend a short time in Southern Rhodesia, where facilities will be afforded for an unofficial study for comparative purposes of the principles and methods of native administration followed there. This study, it is anticipated, will be of great value when further consideration is given to the difficult questions of native policy in the Rhodesias and Nyasaland, to which attention is directed in the Report of the Rhodesia–Nyasaland Royal Commission (see NATURE, 143, 829; 1939).

International Co-operation and African Studies

INTERNATIONAL co-operation, which in recent years has contributed so markedly to progress in African studies, is now necessarily much curtailed. Nevertheless, the International Institute of African Languages and Cultures, although its existence as an international institution seemed to be threatened, has decided that, so far as possible, its work must continue. In a communication over the signature of Lord Lugard, chairman of the Executive Council, which has been circulated to the members of the Institute, the reasons for the decision are given. Science, it is pointed out, is neutral, and further, the

peoples of Africa, in war as much as in peace, need all that science can do to promote their welfare and advancement. "It seems to us important," says Lord Lugard, "that public interest in the welfare of the African peoples should not be 'blacked out' by a too exclusive concentration on events in Europe", adding "we are convinced that the Governments which have accepted responsibilities in Africa will not wish the war to put a stop to the various efforts at the social progress of its peoples, which they have initiated in years of peace." That this view is justified is borne out by the mission undertaken by Lord Hailey at the request of the Colonial Office, to which reference is made above. Further, if the War of 1914–18 may be regarded as a precedent, the problems of native Africa, when peace comes, will not be such as can be solved by improvisation, but only on a basis of the results of carefully digested scientific study over a considerable period.

African Native Institutions and Christianity

A STRIKING instance of the adaptation of African institutions and ways of thought to the promotion of Christianity after intensive study is contributed to the current issue of *Africa* (13, 1, January 1940) by Prof. N. de Cleene. Incidentally, it illustrates the flexibility, to which reference is often made, of Catholic Missions in dealing with native races. In response to a suggestion made by Prof. de Cleene that native art might be of service in the Christianization of Africa, the R. P. A. Walschap, a missionary in the Belgian Congo, made a scientific study of native music and the dance. Being struck by the predominating part played in native appreciation by the element of rhythm, not only did he introduce it into his church services, composing a mass and other music in native style, to be sung to the accompaniment of native instruments, but he also arranged a series of religious dances, in the native convention, for performance at the religious festivals of the Church. The result was a remarkable accession of interest and understanding.

The second example makes use of the graphic arts. The R. P. Vandenhoudt, from the time of his arrival on the Lower Congo some years ago, had made a study of the principles, methods and concepts of native graphic art. He was much struck with native ability in making crude but graphic representations of scenes and events in everyday life. He thereupon conceived the idea of representing scenes from the Holy Scriptures according to native concepts and in native technique. Among a number of scenes to which the method was applied, the most successful, and one which was immediately understood, was the sacrifice of Isaac by Abraham, in which the intended victim was represented according to a native custom, in which the head of a man condemned to be beheaded was fastened to the bent bough of a tree and shot into the air when the fatal blow was struck.

The British Museum (Natural History)

THE important entomological collections, manuscripts, etc., bequeathed by the late William Miller Christy have been received at the Museum. The total number of specimens is 21,312. The collection consists entirely of British Lepidoptera, and includes a large number of specimens which will be of great value as additions to the existing British collection. Mrs. Brownlow, who inherited them, has presented to the Museum a large number of important entomological books from the library of the late Mr. Christy. Further specimens of vanadinite (lead vanadate), including a doubly terminated crystal from Abenab, South West Africa, have been presented to the Department of Mineralogy by Mr. J. N. Justice, and the Department has also acquired two fine specimens of the rare potassium barium zeolite harmotone collected during the summer of 1939 at Ben Resipol, Argyll.

The Trustees of the British Museum decided at their meeting on January 26 that certain of the galleries in the Natural History Museum should be opened to the public on Saturday and Sunday afternoons, beginning on February 3. Much material has been evacuated for greater safety, and many exhibits have been protected in their places in the galleries. There remains, however, a very large proportion of the exhibits in certain galleries, and the Trustees are anxious that the public should have access to them so far as possible. In addition, it is hoped to organize a number of special exhibits of topical interest, about which a further announcement will be made at a later date. The hours of opening will for the present be from 1 p.m. to 4 p.m. (on Saturdays and Sundays only), but the closing hour will be extended as soon as the lengthening of the days and the introduction of summer time make this practicable. Children below the age of twelve will not be admitted unless they are in the charge of an adult, and visitors are requested to carry gas masks.

The Newcomen Society

AT a meeting of the Newcomen Society held at the Institute of Marine Engineers on January 17, Eng.-Capt. E. C. Smith read the second part of his paper on "The First Twenty Years of Screw Propulsion 1838–1858". Having in Part 1 dealt with the work of John Ericsson in the United States, Capt. Smith gave a review of the early progress of screw propulsion in both the Royal Navy and the British Mercantile Marine. The first screw vessel in the Royal Navy was the curious little *Bee* of 33 tons and 10 horse-power built in 1842 and fitted with a side-lever engine driving both paddle-wheels and a screw. The *Bee* for many years was attached to the Royal Naval College, Portsmouth, for the instruction of officers in steam. The first screw man-of-war in the Navy was the sloop *Rattler*, the trials with which in 1844–45 led to the screw being adopted for practically all naval vessels. By 1850 there were about forty screw ships in the Fleet, by 1858 and about 350. Generally speaking, in the larger wooden ships the screw was regarded as an auxiliary and was fitted so that it could be lifted out of the water.

The first mercantile screw vessel to make a sea voyage was the *Novelty* of 1841. The famous iron screw ship *Great Britain* was laid down in 1839 and completed

in 1845. She was the first screw ship to cross the Atlantic, but a regular service to America by iron screw ships was not started until 1850, when the *City of Glasgow*, the first ship of the old Inman line, made her appearance. The year 1850 also saw the mails sent from Plymouth to the Cape for the first time by steam. Quite small iron vessels were used, and some of them were fitted with Joseph Maudslay's feathering screw. By January 1, 1857, the Board of Trade register included about five hundred screw-driven vessels, nearly all of them being constructed of iron. A second paper read at the meeting was by Mr. A. S. Davies, and consisted of some extracts from the ledgers of the Coalbrookdale Company relating to castings for Newcomen engines between 1717 and 1769.

X-Rays in Industry

METHODS of utilizing X-rays in industry were discussed in a lengthy paper by Mr. H. P. Rooksby, of the Research Laboratories of the General Electric Co., Ltd., in a paper read before the Royal Society of Arts on January 17. The methods of utilizing X-rays fall into two groups which depend (*a*) upon their power of penetration through various materials, and (*b*) upon their reflection by the regular arrangement of atoms in crystalline substances. The varying resistance of materials to penetration by X-rays enables a kind of density picture of a complex object to be obtained by irradiating the object with X-rays and examining the emergent beam by means of a photographic plate or fluorescent screen. This use is widely known.

Another use for X-rays concerns the continuous series of solid solutions formed by luminescent zinc/cadmium sulphides. Members of this series are used extensively in the manufacture of the screens of the cathode ray tubes, and for colour modification of certain mercury vapour discharge lamps. New fluorescent colours are often obtained by blending two zinc/cadmium sulphides of different compositions. A chemical analysis alone will not reveal when this has been done. The X-ray method enables the composition of both phases to be determined, as each phase will show up separately on the X-ray pattern. In some manufacturing processes, it is necessary to determine what effective heat treatment has been given to a sample of coke or 'amorphous' carbon. It is found that the ultimate particle size of amorphous carbon depends more upon the actual temperature of heat treatment than upon any other factor, so that the temperature to which a given sample has been treated can be ascertained with reasonable accuracy by comparison of its X-ray pattern with those of the standard period of cokes. In conclusion, the author emphasizes the fact that few recognize how wide is the scope of X-ray analysis. Certain physical properties such as the coefficient of expansion, which can be easily measured in the classical way, have also been measured by X-ray methods, and satisfactory agreement has been found. These new methods should not be regarded as merely repetitive, for new aspects of the physical property may be revealed by the new method of approach.

The Friendship of Boyle and Wren

IN a recent paper (*Bull. Hist. Med.*, 7, 970; 1939) Ruth Musser and John C. Krantz, jun., relate that Robert Boyle and Christopher Wren first became acquainted in London in 1648 when Boyle was aged twenty-one and Wren sixteen. In 1664, when both were at Oxford, Wren, who had been made Savilian professor of astronomy four years previously, conceived the idea of conveying medicines or poisons directly into contact with the blood of animals by inserting pipes directly into their blood vessels. The experiment was carried out on a dog in collaboration with Boyle at an Oxford meeting of the Royal Society at Wadham College, of which Wren was a member. The first experiment was made with a warm infusion of opium which was injected into one of the superficial veins of the dog's hind leg and produced profound stupor in the animal. Afterwards, experiments were made with an infusion of brown antimony oxide, which caused vomiting and was nearly fatal. Diuretics were injected at the suggestion of a famous physician who may have been Willis, and lastly transfusion of blood from one animal to another was carried out with considerable success. The experiments were brought to an end by the outbreak of plague in the summer of 1665, when Wren went to Paris, but the friendship of these two great men continued, owing to their activities connected with the Royal Society, until Boyle's death in 1691.

Meteorology in India

THE report on the administration of the Meteorological Department of the Government of India in 1938–39 covers a period during which an important stage in the re-organization of the department was completed. The scheme was planned to involve no increase in the budget grant and yet to give the following additional facilities: (1) an afternoon weather chart for the headquarters office at Poona; (2) the re-establishment of the forecasting centre at Delhi; (3) the establishment of a wireless station at Poona; (4) re-organization of the superior staff; (5) the transfer of the upper air office from Agra to Delhi; (6) an increase of staff in the R.A.F. Meteorological Offices and the setting up of additional observatories in North-West India.

The aerological observatory at Agra dates from 1914. It was originally just a research station, and the position was chosen solely with the view of getting the maximum possible information about the upper atmosphere with the aid of sounding balloons. The growth of aviation has involved the observatory in an ever-increasing number of administrative and purely utilitarian activities, and for these Agra is a backwater. It is accordingly being transferred to a new 20-acre site that has been chosen at Delhi, where it can come into closer contact with aviation interests and where it will have access to the upper wind charts prepared in the normal routine of daily forecasting.

The Imperial Council of Agricultural Research continued to finance the Agricultural Meteorology Section, although proposals were under considera-

tion for making the section a permanent part of the department. New developments in this section included the construction of a 35 ft. tower at the Central Agricultural Meteorological Observatory, for the study of exchanges of heat and moisture between the surface layers of the soil and the atmosphere. The Calcutta office issued storm warnings during sixteen periods of disturbed weather over the Bay of Bengal. The outstanding cyclone of the year in that region was that of October 5–12, 1938, which on approaching land caused much damage and some loss of life in the Ganjam district when sea waves inundated the coastal areas and swept away houses and cattle. The Poona office had a greater number of disturbed periods to deal with over the Arabian Sea, and one cyclone redeveloped into a very severe storm early in October after having weakened during its passage across the Peninsula from the Bay of Bengal.

The Bureau of Human Heredity

THE Bureau of Human Heredity is carrying on, though with reduced activity, during the War. Although some international connexions are cut off, a compensation is the possibility of obtaining a median sample of the population through the careful examination of entrants for the Services. This is not to be lost sight of, as collaboration with medical men in examining and collating genetical conditions would be of great importance in furnishing figures of medical, anthropological and genetical value. Although the Bureau has lost several workers, it has enlisted the support of Prof F. A. E. Crew as honorary medical secretary. Correspondence with men of science in other countries continues, but in diminished volume, which may give time for other projects, including (1) surveys of the genetic background in tuberculosis, (2) the human analogue of the transmission of cancer in animals, (3) certain immunological problems. It is hoped also to compile a preliminary list of inherited disorders and defects based on recent research for the use of practitioners and teachers. The address of the Bureau is 115 Gower Street, London, W.C.1.

Cereals for Spring Sowing

THE National Institute of Agricultural Botany has just issued a war-time leaflet (Farmer's Leaflet, No. 2, "Varieties of Cereals for Spring Sowing"). Its appearance is opportune, for it both presents an epitome of spring oats and barley in the light of their general utility, as well as their possible substitution on land which was primarily intended for wheat, but which may yet be unsown owing to unfavourable weather. There are also some varieties of wheat normally used for autumn sowing which can be sown up to the end of February with reasonable chances of success. Quality in home-grown wheat at the moment is in abeyance; but other things being equal, the same condition does not apply to oats. These are mainly intended for consumption on the farm, and the value of oat grain for all forms of stock feeding is determined by the amount of husk the grain contains. Thus, where the farmer is in a position to exercise a preference, it should be in favour of a variety with as thin a husk as possible.

In recent years nothing has happened to impair the reputations of Spratt-Archer and Plumage-Archer barleys amongst farmers and maltsters, and in general the recommendation of these varieties cannot be improved upon There is, however, a case for the Danish varieties Kenia and Maja on rich soils, since both these barleys are early in ripening and both possess shorter and better standing straw than either of the two varieties mentioned above. On less rich soils, and where earliness in ripening is a requisite, the native varieties Standwell and Maltster may be utilized with advantage. Copies of the leaflet may be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

Mr. A. H. Mackmurdo

THE communication entitled "The Social Organism", printed on p. 187 of this issue, has additional interest in the age and associations of the author. Mr. Mackmurdo, who is eighty-nine years of age, is believed to be the only man living who can claim to have been a friend both of Charles Darwin and of Herbert Spencer. For many years he worked with Spencer, and seventy years ago, at the age of nineteen years, he began his subscription to NATURE at the suggestion of Charles Darwin.

Announcements

CAPTAIN ROBERT KEMP has won the Buckston Browne prize for 1939 with an essay on the value of periodic medical examination in middle life.

DR. ETIENNE BURNET, director of the Pasteur Institute of Tunis, has been made a Commander of the Legion of Honour.

DR. C. G. DARWIN will deliver the thirty-first Kelvin Lecture of the Institution of Electrical Engineers on April 25, at 6 p.m. The title of Dr. Darwin's lecture will be "Thermodynamics and the Coldest Temperatures".

MESSRS. W. AND R. CHAMBERS, LTD., announce the early publication of "Chambers's Technical Dictionary". This single volume work contains terms drawn from many branches of scientific and industrial activity, and is under the editorship of C. F. Tweney and Dr. L. E. C. Hughes.

IN memory of the late Prof. V. R. Williams, the Russian authority on soils, the Timiryazev Agricultural Academy in Moscow has founded three annual prizes to be awarded for the best work on soil study and cultivation. The first prize is of 5,000 roubles, the second of 3,000 roubles and the third of 1,500 roubles. The Commissariat of Agriculture is preparing for publication a complete collection of Prof. V. R. Williams' work. New editions of the most important of them will be published this year.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 191. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

3 : 4-Benzpyrene, Paramecium and the Production of Tumours

THE blastogenic hydrocarbons are photodynamic; therefore, in order to observe their action on living cells, cultures must be kept in the dark, and examined in light not shorter than 410 $\mu\mu$. Under these conditions, using 3 : 4-benzpyrene and Paramecium, it has been shown that growth-rate is increased; this effect thus reproduces in a test-tube the increased cell-growth observed when the hydrocarbon is applied to the tissues of vertebrates, for example, the hyperplasia of the epidermal cells, when the skin of mice is painted[1].

Continuing this line of research, I have tried to reproduce the conditions under which tumours arise. This has necessitated the cultivation of Paramecium for a long time in a medium containing 3 : 4-benzpyrene; to keep the cultures going, they had to be sub-cultured two or three times a week.

Two sets of experimental cultures were maintained, containing one in a million benzpyrene, and one in five hundred thousand. In the latter, a few large organisms of abnormal shape were found on the sixty-second day. Similar abnormal organisms were also found in the one in a million cultures on the hundred and twenty-second day. This strain of Paramecium has been continuously under observation for more than two years and never have any abnormal forms been seen, either in control or experimental cultures.

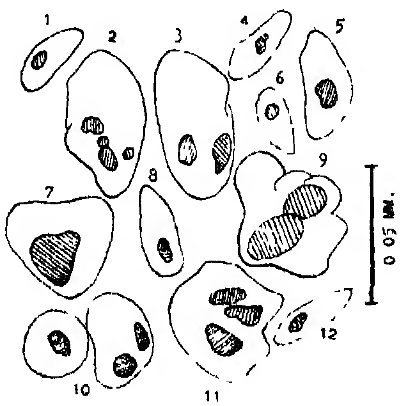


Fig. 1.

OUTLINE DRAWINGS OF SPECIMENS FIXED IN 'SUSA' AND STAINED WITH CARMALUM.

The ruled areas are macro-nuclei; Nos. 1, 4, 6, 8, 12 are normal Paramecia; No. 10 is about to divide into two.

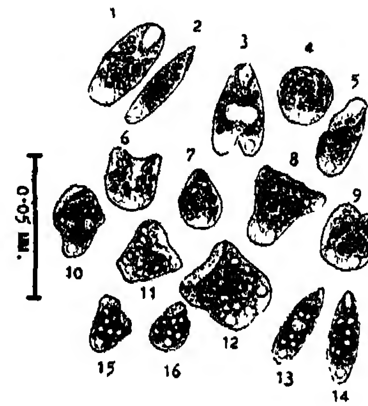


Fig. 2.

THE APPEARANCE OF LIVING INDIVIDUALS IN A STRONG SOLUTION OF GUM ACACIA.

The dotted circles are contractile vacuoles; the other circles food vacuoles; the macro-nucleus in 3, 10 and 13 is shown dotted with a full line margin; Nos. 13 and 14 are normal individuals; No. 2 is a side view of No. 1; No. 9 shows No. 8 contracted; Nos. 8, 11 and 12 swim like Vorticella, the others swim in wide irregular spirals.

The experimental cultures never underwent conjugation. Furthermore, after the abnormal specimens were removed from the cultures, the cultures continued to present only normal forms. Later, single abnormal forms again occurred in the one in five hundred thousand culture on the eighty-third day, and in the one in a million on the one hundred and sixty-fifth day.

The abnormal specimens were picked out and placed in normal media as single-cell cultures: they grew into populations of abnormal Paramecia, some many times the normal size, some midgets, some 'Siamese twins', some triplets, some no more than knobbly monsters, some presenting little departure from the normal and some apparently quite normal.

Outline drawings of some of these fixed with 'Susa' and stained with carmalum are shown in Fig. 1; examined in gum, their appearance in life is well seen and illustrated in Fig. 2.

These abnormal forms have been sub-cultured in normal medium for several months by picking out single individuals. When sub-cultured by using a platinum loop, normal forms, which are often the progeny of the abnormal, quickly outgrow the abnormal, which thus become lost.

Breeding out various abnormal forms shows how this comes about: certain of the abnormal types,

especially twins and triplets (Fig. 2, Nos. 3, 10 and 12), throw normal as well as abnormal individuals. Some of the abnormal forms, however (Fig. 2, Nos. 7, 11, 15 and 16), breed true and have been kept in pure culture for many generations by sub-culturing with a platinum loop. Thus, long exposure of Paramecium to benzpyrene results in the production of a set of polymorphic cells. Here we have a striking resemblance to the assemblages of cells of which tumours are composed; it is well known that the cells from a single tumour are widely polymorphic both in size and structure: for example, their content of chromosomes may be either normal, above the normal, or below; cells with many times the normal number are common.

The similarity between the formation of a tumour by benzpyrene and the changes observed in Paramecium thus embraces the following facts:

(1) They occur among cells long stimulated to a growth-rate above the normal.

(2) They occur only after long exposure to the hydrocarbon.

(3) Only a very few of the exposed cells present the change.

(4) Once the change has occurred, it is reproduced by cell division for many generations after the hydrocarbon has been removed.

(5) The population of cells which result show wide morphological variation.

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Jan. 1.

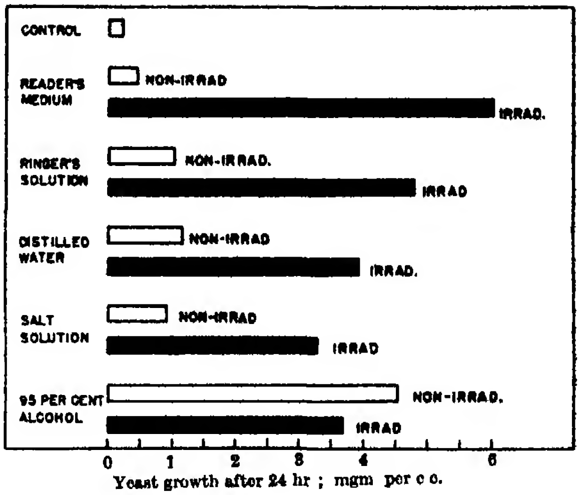
[1] NATURE, 144, 154 (1939).

Effect of the Suspending Medium on the Production of Growth Factors by Injured Cells

IN investigating the production of proliferation-promoting intercellular wound hormones by cells injured by various means[1], a study has been made of the effects of the suspending media on the production of the factors by cells injured with lethal ultra-violet radiation

Reasoning that if the proliferation promoters are physiological products of living cells, the ratio of the production of the factors by irradiated and non-irradiated cells should be greatest when they are suspended in a favourable medium, containing nutrient material, a comparison was made of the production of the factors in distilled water, isotonic sodium chloride, Reader's medium[2], 95 per cent ethyl alcohol, and Ringer's glucose phosphate solution. Yeast was suspended in these media at a concentration of 100 gm. per litre. All suspensions were irradiated simultaneously with lethal ultra-violet until there was practically complete killing in the salt solution. The suspensions were then filtered through Berkefeld *N* filters, and the filtrates taken to dryness and made up to five times their original concentrations. These solutions were assayed on yeast according to techniques previously described[3].

The results of typical assays are shown in the accompanying illustration. The greatest production of the factors by irradiated cells and the least by



non-irradiated cells occurred in the most favourable medium (Reader's). Next followed Ringer's glucose phosphate solution. In distilled water and salt solution, in which the cells had no nutrient supply, the ratio of irradiation products to controls, as well as the potency of irradiation products, were less, as would be expected if the factors were elaborated by living cells and not simply extracted from killed cells. There was somewhat greater release of proliferation-promoting factors by both non-irradiated and irradiated cells in distilled water as compared with salt solution, evidently due to the lowered osmotic pressure in the former favouring extraction. In alcohol, irradiation led to less, instead of greater, yields, the toxic effects of alcohol and irradiation together apparently killing the cells too quickly to permit as great elaboration of the factors as in alcohol alone. Were the factors dead-cell disintegration products, one would not expect any decreased yield in alcohol as a result of irradiation unless irradiation destroyed the active factor. That this could not have accounted for the lesser yields obtained was determined by separate experiments on the irradiation of active filtrates, the degree of inactivation being negligible under the conditions of the experiments.

The results indicate that disintegration of dead cells cannot account completely for the proliferation-promoting products obtained from injured cells, and support the hypothesis that injured cells release such factors into their suspending media as a physiological response to injury.

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Dec. 7.

[1] Fardon, Norris, Loofbourow and Ruddy, NATURE, 139, 589 (1937); Sperti, Loofbourow and Dwyer, NATURE, 140, 643 (1937); *Studies Inst. Divi Thomae*, 1, 163 (1937); Sperti, Loofbourow and Lane, *Science*, 86, 611 (1937); Loofbourow, Cueto and Lane, *Arch. exp. Zellforsch.*, 22, 607 (1939); Loofbourow and Dwyer, *Science*, 88, 191 (1938), NATURE, 143, 725 (1939), *Studies Inst. Divi Thomae*, 2, 155 (1939); Loofbourow and Morgan, *J. Bact.*, 39 (1939), in the press.

[2] Reader, *Biochem. J.*, 21, 901 (1927).

[3] Loofbourow, Dwyer and Morgan, *Studies Inst. Divi Thomae*, 2, 137 (1938).

Under Coat of the Platypus

As a refugee from China where, at Chiao-Tung University and the Lester Medical Research Institute, I had been studying the structure of the wool fibre, I was offered the hospitality of the Zoological Department of the University of Melbourne by Prof. W. E. Agar, and the investigations there carried out have given rise to the matters here brought under discussion

To disintegrate the wool fibre I had reason to steep it in a concentrated solution of caustic potash from a half to three hours. On washing in water, after this steeping, a curious phenomenon was witnessed. The wool fibre took on a beautiful regular curvature. On treating a medullated fibre in like manner, although the fibre in its natural state was perfectly straight, after treatment it took on the curvature shown in Fig. 1 with the medulla broken into short lengths. It at once occurred to me that these lengths each represented a day's growth. If this were so then there would be approximately 365 of these for a year's growth, and multiplying this number by the unit length should give the fibre length of one year's growth. This I found to be approximately correct.

One explanation of the effect here observable appears to be that the cortex of the fibre contracts while the medulla does not do so and consequently is constrained to take up the positions shown. A normal wool fibre without medulla shows a similar curvature when similarly treated, this probably being due to the different contractions of scale sheath and cortex. The periodicity of the break along the normal wool fibre is about equal to twelve diameters, that is, about one hundredth of an inch with a typical Merino wool fibre. The curvature of the wool fibre in the lock or staple is partly to be attributed to this periodicity and partly to the varying lengths of fibres composing each staple. Thus the shorter fibres decide the length of the staple and the longer fibres, of necessity, take on the curl or crimp to fit themselves to this length. On looking at the coat of the platypus in the University Museum, I was naturally struck with the 'ladder' structure shown in Fig. 2, and it was but a step further forward to ask: Is this ladder structure due to the daily periodicity—does each ladder represent a day's growth of the fibre?

By the kind collaboration of Mr. Kendall of the Melbourne Zoological Gardens and Mr. David Fleay of the MacKenzie Sanctuary, Healesville, near Melbourne, I was able to obtain fibres from two animals of known age, and on testing out the theory I was surprised and naturally delighted to find the wonderful coincidence as shown in the following table:

Fig. 1.

MEDULLATED FIBRE CURVED AFTER TREATMENT WITH CAUSTIC POTASH. (× c. 36).

Unit length approximately $\frac{1}{3}$ and $\frac{1}{3}$ of $\frac{1}{20}$ = $\frac{1}{60}$ or 60 breaks per inch. And 365 days ÷ 60 = 6 inches, length of fibre for one year's growth.

Fig. 2.

LADDER STRUCTURE OF UNDER COAT OF PLATYPUS. (× c. 330).

One ladder = $\frac{1}{8}$ in., and 440 × 8 = $\frac{1}{3520}$ length of each ladder. Fibre $\frac{1}{2}$ in. long, therefore $\frac{3520}{2}$ = 1760 ladders or days. And $\frac{1760}{365}$ = 4 years and 300 days. (Age of Animal).

	A	*B*	*C*	*D*	*E*
Fibre length	$\frac{1}{2}$ in	$\frac{1}{4}$ in.	$\frac{1}{4}$ in	$\frac{1}{2}$ in.	$\frac{1}{3}$ in.
Length of ladder	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$
Ladders per fibre	1500	750	750	1500	1000
Age by ladders	$4\frac{1}{8}$	$2\frac{1}{18}$	$2\frac{1}{18}$	$4\frac{1}{8}$	3 (nearly)
Actual age	Well over $2\frac{1}{2}$	2+	2+	Not known	Not known

A is the Zoo platypus; *B* "Jack" from the Sanctuary; *C* "Gill" from the Sanctuary; *D* from the University Museum; and *E* a stuffed specimen from the Zoological Gardens.

Thus, however, seemed too good to be true, so I set to work to examine each coat thoroughly, and to my chagrin I found a fibre in the coat of Gill, one of the Sanctuary animals of known age, much too long to fit in with my theory. At the same time, however, I noticed the waved character of the fibres and, from my experience with wool staples and fibres which had shown a similar effect due to the variation in lengths of the fibres composing the staple, I at once thought of different rates of fibre growth which would account for this long fibre. But if my theory were correct there would only be the same number of ladders upon this longer fibre as upon the shorter fibres—in other words, the ladders would be longer. On measuring the ladders on this longer fibre I found that they were longer and that consequently on the longer fibre there would only be the same number of divisions as on the shorter, slower growth fibres. The following are the details:

For *C* ("Gill" from the Sanctuary):

Longest fibre	$\frac{1}{4}$ in.	Average fibre	$\frac{1}{4}$ in.
Length of ladder	$\frac{1}{2650}$	" "	$\frac{1}{3000}$
Ladders per fibre	663	" "	750
Age by ladders	$2\frac{1}{4}$	" "	$2\frac{1}{18}$
Actual age	2+	" "	2+

As these ladders are approximately only about one three thousandth of an inch in length, it is wellnigh impossible to count the ladders for even a two years' growth. It would seem, however, that the theory here set forth, that each ladder represents a day's growth of the fibre, is likely to be correct.

There is, however, one other matter to be considered which might invalidate the whole argument: Is the coat of the platypus composed of life-length fibres or only of year's-growth fibres? Does the platypus retain its under coat for its life or does it 'moult' or cast its coat yearly? Curious to relate, certain animals, such as the musk ox, cast their under coat yearly, but the Merino sheep, which according to the late Prof. Cossar Ewart has thrown off the outer hair coat of the wild sheep and retained only the under coat, does not cast this under coat: Merino sheep have been sheared carrying a five-years' growth of wool.

I would therefore ask the help of other workers in the elucidation of the two problems basic to the theory here advanced.

(1) Do the animals carrying a 'laddered' under coat cast this coat yearly, or do they retain the under coat for life, the life-histories of the animals being shown on the fibres just as the age and history of a tree are revealed by the rings from bark to centre?

(2) Is the 'ladder' truly representative of a day's growth of the fibre in the case of animals other than the platypus which show this ladder structure of the fibre?

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The Social Organism

IN the last few years science has thrown her searchlight upon social physics, making amazing discoveries. She shows that there are laws underlying social physics as immutable as those she has discovered in material physics. This fact compels the assumption that the evolution of social bodies follows the pattern of all organisms in an increasing specialization of parts with a reciprocal unification of structure. This means also that a society in its evolution becomes a social organism. The facts disclosed by science lead to no other interpretation.

In our study of natural history which now includes the history of societies, we find that all beings—mechanical, vegetal and animal—may be classed in a serial order ranging from the most simple to the most complex, and from a motor-car to a social organism. In the inevitability of this order man will find he has a sure guide to control his interference with and to direct his assistance to Nature's process of social evolution. Hence the call everywhere heard for the help of science in the work of social organization.

So long as we ranged social phenomena as a class apart from physical phenomena, science could not pass the frontiers of the latter. She had to concentrate upon improvements in mechanics and chemistry.

One cannot organize a heap of sand. Before a body can be organized there must be some binding element tending to integrate its diverse parts into a whole. This necessity becomes more evident as organisms rise in the order of their complexity. In the long past this binding element was supplied by the general concept of a superhuman power. To-day this concept is no longer general. Societies have been trying to pull themselves together either by a common defence of material possessions or by a common defence of personal rights.

But science alone can supply the missing link between the individual and society. This link is in the new conception of the social body as an organism in process of development.

The supernatural concept of the past had reference only to the individual, and in its decay it has given rise to an unrestrained individualism which has engendered disorganization and disruption instead of organization and integration.

A modern society is composed of individuals who are forced to live in association and to maintain their life by co-operation. This is the new phase and one pointing directly to the organization of the maintaining activities in accord with the law of organic life.

In the absence of scientific direction, we have been intensifying the specialization of the individual without any compensating balance in the form of a common conception such as will induce the highly specialized individuals to direct their specialized competence in building up a welfare beyond that of the individual, but one within which the welfare of each would be embodied.

In this lack of any integrating influence in the presence of elements which are in themselves disintegrating, lies the cause of the restiveness and the antagonisms of the present day in almost every European nation.

The universal instinct of man is restless in its search for law and order, and if it find no real law and order outside his own consciousness, he will create a fictitious law and order—Bolshevism, Socialism, and what not.

Here social science, which is the capital science, together with all the sciences preliminary to this, from astronomy to physiology, may keep societies out of the bog into which they are drifting. Never before has science had such an opportunity of educating and directing the civilities which constitute the civilization of mankind. By insistence upon the recognition of each body-politic as a social organism true to type, and by the habit of a conception which will enlarge the aim of science, industry and arts, this enlargement of the social functions will cause a new social structure to arise for their ample accommodation; which sociological structure will follow the pattern of physiological structures.

By the process of evolution millions of unicellular organisms have been brought into organic integration to form a multicellular physiological structure—vegetal, animal or human. By the same process Nature is incorporating millions of individuals in a multipersonal organism. This is the positive fact upon which social science is built.

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Jan. 5.

Energy Changes Accompanying Magnetization

IT is generally stated that the heat evolved in a hysteresis cycle is given by the expression $\int HdI$, where I is the intensity of magnetization of a ferromagnetic specimen in an effective field H, although it is very difficult to provide an adequate proof of this statement. In recent years several attempts have been made to investigate the heat liberated or absorbed when a ferromagnetic is taken through the several stages of a single hysteresis cycle step-by-step. Thus, Adelsberger[1] found that the total quantity of heat liberated by unit volume of a hard steel in a single complete cycle is equal to that calculated from $\int_{-H}^{+H} HdI$, and so provided a proof of what is known as Warburg's Law.

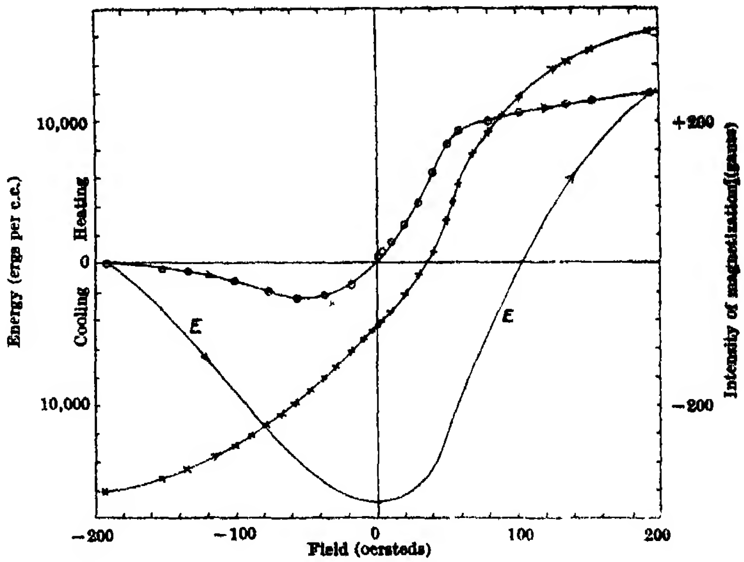

FIG. 2.
STRESS 8·67 kgm./mm.².

Now, while there is little doubt about the correctness of this law, there is much uncertainty about the heat changes accompanying the magnetic changes taking place when a cycle is described in a step-by-step process. This is because the temperature changes are exceedingly small; for example, in the very favourable case of a hard steel, the total rise in temperature when its magnetism is reversed in an ordinary laboratory experiment is only about 0·005° C. Consequently, all experiments which have hitherto been made have relied either upon the use of multiple thermojunctions electrically insulated from, but in thermal contact with, a ferromagnetic rod, or upon the use of multiple specimens, each of which acted as one metal of a thermocouple, or upon the use of a divided specimen to each portion of which a thermojunction was attached, the several thermocouples being connected in series to a sensitive galvanometer. References to these experiments will be found in a recent paper by Hardy and Quimby[2].

We have recently developed in this laboratory a new and sensitive method which permits the measurement of sudden changes in temperature when some twenty thermojunctions are connected directly to an undivided rod about 5 mm. in diameter and 40 cm. long. Incidentally, the method could readily be used to measure the rate of change of the modulus of rigidity of a metal with rise in temperature. The great advantage of our method is that it enables us to measure the thermal changes accompanying magnetization processes when the rod is subjected to a steady severe longitudinal stress. In this way we have been able to obtain measurements with a hard-drawn, unannealed nickel rod, 99·67 per cent pure, the main impurity being magnesium, kindly supplied by Dr. L. B. Pfeil, of the Mond Nickel Company Research and Development Department, when under tensions of 1·70, 3·72, 5·28, 8·67, 12·1, 21·4 and 31·2 kgm. per sq. mm.

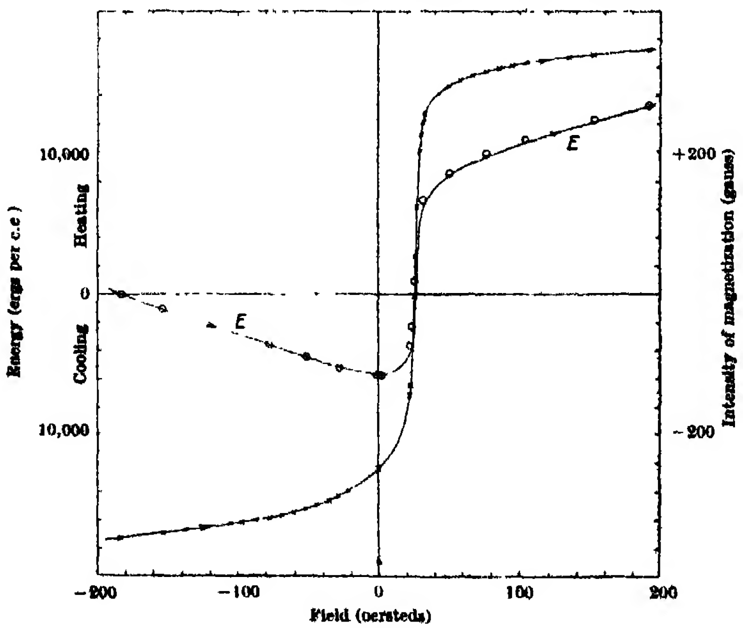

FIG. 1.
ZERO STRESS.

Some of the results are shown in the accompanying graphs, in which the curves drawn through the crosses are the I, H curves, the curves E represent the energy changes calculated from the I, H curves on the assumption that the expression $\int HdI$ is adequate, while the encircled points are the results of our direct measurements. Fig. 1 refers to the unstretched nickel rod, and here the agreement between the calculated and the measured results is extra-

ordinarily close. In our view, it is fortuitous, as we have not found such close agreement with another, slightly purer, specimen. Fig. 3 refers to the same rod under the severe stress of 31·2 kgm. per sq. mm., and is very interesting because all trace of cooling on demagnetization has vanished and no reversible changes of any kind appear Now, Becker[3] deduces that in the case of heavily stretched nickel the entire magnetization is caused by reversible rotation of Weiss domain vectors which are forced by the severe tension to set perpendicularly to the axis of the rod in the absence of a longitudinal field. Our experiments therefore show that such processes are unaccompanied by measurable heat changes. The results of Fig. 2 are for the same rod loaded to 8·67 kgm. per sq. mm., and represent a transition stage between those of Figs. 1 and 3.

In conclusion, we wish to direct attention to the proof of Warburg's law, the lack of correspondence between the calculated heat changes and those measured directly in step-by-step alterations of H, and the significance of the measurements on nickel under severe tension arising from these experiments. It is hoped to publish a complete description of the method and the measurements on nickel and several nickel alloys in the near future.

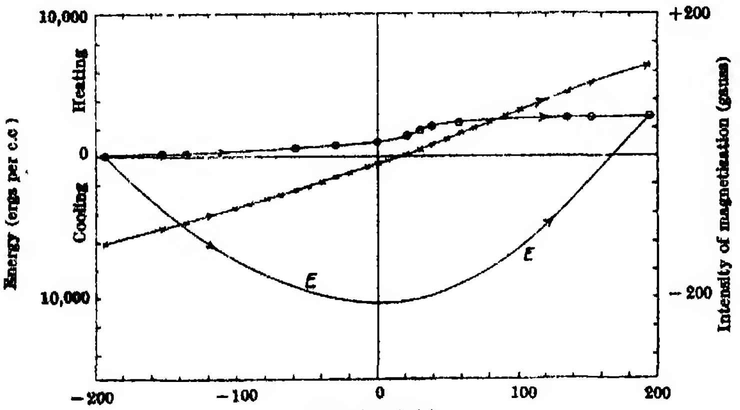

FIG. 3.

STRESS 31·2 kgm./mm.^{2}.

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Dec. 20.

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[1] Adelsberger, U., *Ann. Phys*, 83, 184 (1927).
[2] Hardy, T. C., and Quimby, S L., *Phys. Rev.*, 54, 217 (1938).
[3] Becker, R., and Döring, W., "Ferromagnetismus", p. 111 (1939).

Diffraction of Convergent Electron Beams

IN a recent paper[1], Kossel and Möllenstedt describe some beautiful experiments on the diffraction of convergent electron beams by transmission through thin crystals. Whereas very thin crystal flakes (or flakes of not perfectly uniform thickness ?) show the diffraction pattern of a two-dimensional lattice, the diffraction spots of mica crystals some 500–1000 A. thick show a fine structure of approximately equidistant stripes (Fig. 1) which Kossel and Möllenstedt interpret as being due to the secondary maxima of the Laue interference function

$$\frac{\sin^2\left\{\frac{2\pi}{\lambda}\cdot\frac{N}{2}c\,(\cos\theta_m-\cos\theta)\right\}}{\sin^2\left\{\frac{2\pi}{\lambda}\cdot\frac{1}{2}c\,(\cos\theta_m-\cos\theta)\right\}},$$

where c is the identity period normal to the crystal surface, N is number of cells in this direction, θ is the angle between incident beam and c, θ_m is the angle between diffracted beam and c. With $\theta_m+\theta=2\theta_0$ (interference condition of the crystal surface[1]), where θ_0 is the Bragg angle of the reflection plane—which is perpendicular to the surface—and considering the smallness of all the angles, this may be written

$$\frac{\sin^2\left\{\frac{2\pi}{\lambda}Nc\,(\theta-\theta_0)\sin\theta_0\right\}}{\sin^2\left\{\frac{2\pi}{\lambda}c\,(\theta-\theta_0)\sin\theta_0\right\}}, \quad . \quad . \quad . \quad (1)$$

which function shows minima for

$$\theta-\theta_0=\frac{md_{hkl}}{D} \quad . \quad . \quad . \quad (2)$$

where d_{hkl} is lattice plane distance, $D=Nc=$ thickness of the crystal, and m is any integer save 0, $\pm N$, etc.

However, this explanation based on the kinematic diffraction theory does not account fully for the details of the phenomenon: The distance between the minima $m=+1$ and $m=-1$ should be twice the distance between the minima m and $m+1$, whereas it is almost invariably much smaller than this expected value. Kossel and Möllenstedt, being fully aware of this fact, describe it qualitatively in terms of a dispersion with direction of the wave-length, as found in the dynamical theory of crystal diffraction. It seemed worth while to apply directly the formulæ given by this theory and, if possible, to test them.

The dynamical theory of electron diffraction by crystals has been given by Bethe[2], who, however, developed it only for the 'Bragg case' (reflection pattern); in working out the theory for the 'Laue case' (transmission diagram) along the lines followed by Ewald and others[3], a complete analogy to Ewald's *Pendellösung* is found, as might, of course, be expected. Neglecting terms of higher order, we find for the relation between the amplitude c_m of the diffracted c_0 of the incident beam:

$$\frac{|C_m|}{|C_0|}=\frac{|V_{hkl}|}{k^2}\;\frac{\sin\frac{1}{2}Dk\sqrt{(\theta-\theta_0)^2\sin^2 2\theta_0+\frac{|V_{hkl}|^2}{k^4}}}{\frac{1}{2}\sqrt{(\theta-\theta_0)^2\sin^2 2\theta_0+|V_{hkl}|^2/k^4}}, \quad (1a)$$

where $k=\frac{2\pi}{\lambda_{cr}}$, where λ_{cr} is the wave-length of the electron beam, modified by the average crystal potential; and V_{hkl} is the structure factor for the electron diffraction against the plane hkl.

In contrast to (1) it is seen that the argument of the sines in (1a) can no longer assume the value 0, its minimum value being $\frac{DV_{hkl}}{2k}$. Taking the experimental conditions of Kossel and Möllenstedt,

$D \approx 10^3$ A, $\lambda = 0.058$ A., this will not exceed π unless V_{hkl} is greater than about 3 volts, which corresponds to a strong reflection. Minima are thus found at

$$\theta - \theta_0 = \pm\, d_{hkl} \sqrt{\frac{m^2}{D^2} - \frac{|V_{hkl}|^2}{4\pi^2 k^2}}, \quad . \quad . \quad (2a)$$

where $m = 1, 2, 3$ . . etc.

With large m or small D, the second term under the root can be neglected compared to the first, thus leading to (2), Kossel and Möllenstedt's formula. It is easily seen that the dynamical correction term has the greatest relative influence on the distance between the first minima on either side of the maximum at θ_0; in the distances between minima on the same side of θ_0 the correction terms cancel to a great extent, in accordance with experiment.

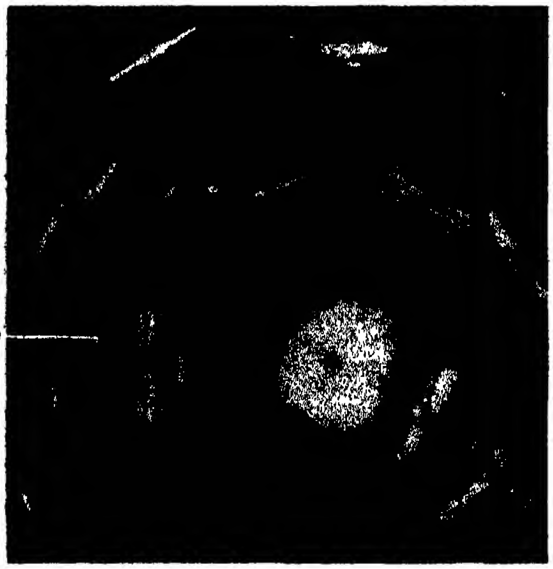

FIG. 1

TRANSMISSION PATTERN FROM MICA WITH CONVERGENT ELECTRON BEAMS [1]

To test (2a), V_{hkl} has been computed from the anomalous distances[4] in the diffraction spot on the left-hand side of Fig. 1, corresponding to the reflection (060). (In the figure it is seen that the position of the bands shifts when crossed by a Kikuchi line. This effect being caused by terms neglected in (2a), the distances between minima must be measured outside these regions.)

$$\frac{\theta_{+1} - \theta_{-1}}{(\theta_{m+1} - \theta_m)_{m=\infty}} = 2\sqrt{1 - \frac{|V_{060}|^2}{4\pi^2 k^2} D^2} = 1{\cdot}2,$$

where $(\theta_{m+1} - \theta_m)_{m=\infty}$ has, as a rather crude approximation, been taken from the average value of the bands $\theta_2 - \theta_1$ and $\theta_3 - \theta_2$. With $D = 900$ A. and $\lambda = 0.058$, we find

$$V_{060} = 2{\cdot}3 \text{ volts}.$$

On the other hand, V_{hkl} was evaluated from the known atomic positions in mica, the data of Jackson and West[4] for muscovite having been used:

$$V_{060} = \frac{d^2_{060}\, 6}{\pi\, a\, b\, c \sin\beta} \cdot \Sigma_i (Z_i - F_i) e^{2\pi i\, 6Y_i/b} = 2{\cdot}1 \text{ volts},$$

in striking agreement with the value found above.

It is thus shown to be possible to determine structure factors simply by measuring *distances* between minima in the fine structure of a diffraction spot, without any *intensity* measurement. The applicability in practice of this very remarkable way of measuring structure factors will be confined to crystal flakes of sufficiently uniform thickness; when D is not sufficiently constant, the position of the minima will shift within the region of coherence of the beam, so that the fine structure will disappear.

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Dec. 21.

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[2] Bethe, H. A., *Ann. Phys.*, **87**, 55 (1928).
[3] Ewald, P. P., *Ann. Phys.*, **49**, 1, 117 (1916); **54**, 519 (1917). v. Laue, M., *Erg. d. exakt. Naturw.*, **10**, 133 (1931). Kohler, M., *Ann. Phys.*, **18**, 265 (1933).
[4] Jackson, W. W., and West, J., *Z. Krist.*, **76**, 211 (1931).

Selective Oxidation of Aluminium Alloys

IN a recent communication[1], S. Dobiński and M. Niesłuchowski state that "an explanation of such striking facts as the formation of a layer of pure MgO on the surface of an alloy containing barely one atom of magnesium for about 3,000 atoms of aluminium, chemical arguments are of little help. As a matter of fact, the heat of oxidation of aluminium (namely 190) is much greater than that of magnesium (143) or beryllium (131). 'Preferential' oxidation in the sense of greater chemical affinity of magnesium or beryllium for oxygen, or reduction of the previously formed Al_2O_3 by beryllium or magnesium, can thus scarcely be considered as a probable hypothesis"

The writers overlook the fact that in this case must be compared heats of oxidation which are related to the same amount of oxygen. The heats of oxidation of magnesium and beryllium mentioned above must be compared with the heat of oxidation of aluminium, also related to one atom of oxygen (namely, 126). The chemical affinity of beryllium and magnesium for oxygen is thus greater than that of aluminium, and the preferential oxidation of magnesium and beryllium is in accordance with the difference in chemical affinity of the three oxides.

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[1] NATURE, **144**, 510 (1939).

The Primus Stove at High Altitudes

THE risk of carbon monoxide poisoning from Primus stoves, discussed by Prof. Yandell Henderson and Mr. J. McCullough Turner in NATURE of January 20, was realized at least eighteen years ago. The Mount Everest party of 1922 was warned about this, on Prof. Georges Dreyer's advice. He pointed out how the danger might be aggravated at high altitudes owing to oxygen scarcity, and consequently less complete combustion.

Further, the late Mr. R. P. Hope has pointed out that to melt snow quickly a little should be melted to start with, so as to get some water in the pot before filling it up with snow. This seems plausible, because air in contact with the bottom of the pot must delay heat transmission, and when a pot is filled with snow to start with, the first water to form moistens the bulk of the snow rather than settles on the bottom.

As exploration is at least as popular at high altitudes as in the Arctic, the factors affecting snow melting high up may be of equal interest:

(1) The water vapour from the flame condenses on the cold bottom of the pot. The pot must be slightly tilted, so that the water drains away to its edge. Otherwise it drips on to the burner, decreasing the efficiency, and at times extinguishing the flame.

(2) The fuel efficiency of the ordinary mountain cooker, which has a plain wind screen in place of the annular container of the Nansen type, remains constant up to 15,000 feet, at all events. With the petrol Primus it is about 60 per cent, as against 80–90 given for the Nansen cooker, the figure of 60 applying to heating of water, and not melting snow.

(3) This particular type of Primus has been used up to 17,000 feet, but Mr. Rickmers reported that it then showed signs of not being far below its ceiling

(4) The paraffin Primus, with roarer burner, fails at about 22,000 feet, owing to cooling of the vaporizer, due to the gas having to rise above its level before it finds enough oxygen for combustion. Shortly before the War of 1914-18, Dr. Kellas tried to climb Kamet, and failed to do so largely because he was relying on this kind of Primus for melting snow.

(5) The ordinary silent burner fails at about 26,000 feet, but when modified by enlargement of the holes through which air is admitted to the flame, it continues to function in vacuum chamber up to 31,000 feet. As it approaches this level the flame becomes greatly weakened and enlarged, and clouds of blue vapour get detached, and wander upwards in search of oxygen. This modification was due to Dr. G. M. B. Dobson.

(6) The ordinary Primus pump entirely fails high up, and starts to do so comparatively low down. The safety device against excessive pressure in the container is the large clearance given to the pump barrel, combined with a spring-controlled delivery valve which only opens under a pressure of about two atmospheres. At 15,000 feet air is taken in at about half an atmosphere. It has then to be compressed to about two atmospheres above container pressure before it starts to pass the delivery valve, and the valve closes as soon as the pressure in the clearance space falls to that amount. At higher altitude the pressure may fail to attain the intensity requisite to open the valve. The solution is the substitution of a large nut, specially shaped to fill the clearance space, for the small one at the end of the pump rod.

(7) The rate of combustion with fuels not burnt under pressure rapidly decreases with altitude. Thus, comparative tests made in 1927 at 15,000 feet on Monte Rosa and at sea-level, showed that Meta took twice as long to burn in the Meta Co.'s burner at the former level With methylated in Messrs. Falk Stadelmann's Ideal burner there was a 22 per cent increase in time. As speed is an important factor when wanting a drink, and thirst is much increased with altitude, there is an advantage in the Primus, in that the rate of fuel consumption is independent of altitude, at all events up to 15,000 feet, and presumably above.

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Points from Foregoing Letters

J. C. Mottram finds that long exposure of Paramecium to the tumour-producing hydrocarbon 3 : 4-benzpyrene results in the production of a few abnormal individuals. If these are picked out and cultured in normal medium, populations of cells result, presenting wide morphological variation from apparently normal through varying degrees of abnormality to multicellular monsters. This state of abnormality was retained during reproduction through many generations. These populations resemble in many respects the assemblage of cells forming a cancerous tumour, where also wide morphological variation is found.

J. R. Loofbourow and Sister Cecilia Marie Dwyer, in continuing their investigations of the proliferation-promoting intercellular wound hormones produced by cells injured by various means, give evidence suggesting that disintegration of dead cells cannot account completely for these proliferation-promoting substances. Further support is given for the hypothesis that one response to injury of cells takes the form of release of proliferation-promoting substances into the surrounding medium.

A. F. Barker shows that the medulla of wool fibre on treatment with caustic potash breaks up into short lengths, each possibly representing a day's growth. Further work on the fibre of the under coat of the platypus shows this to have a ladder structure, each division representing about a day's growth. These observations raise further queries that need answering.

L. F. Bates and J. C. Weston describe measurements of the thermal changes accompanying the magnetization of a nickel rod in a step-by-step hysteresis cycle, when the rod is unstretched and also when it is under severe longitudinal tension. The measurements provide an excellent proof of Warburg's law, and show that 90° rotations of the Weiss domain vectors are not accompanied by measurable heat changes.

The fine structure of diffraction spots obtained from mica with convergent electron beams is explained by Carolina H. MacGillavry on the basis of the dynamical diffraction theory. From the distances between successive minima the structure factor of the reflecting lattice plane can be computed in a very simple way.

RESEARCH ITEMS

Nomad Gypsies of Hungary

BIRTH, marriage, death, are the central incidents of gypsy life in the Sárrét of Hungary, as described by Istvan Nagy of Budapest (*J. Gypsy Lore Soc.*, Ser. 3, 19, 1-2; 1940). The Sárrét, a territory of mighty morasses at the eastern end of the great Hungarian plain, which did not begin to be drained until the middle of the nineteenth century, was peculiarly adapted to their nomadic life; but social and economic circumstances forced them to settle in the villages at the beginning of the present century. Some still tend, however, to move from village to village. The Nomad or Tent gypsies were divided into tribes (now obsolete) and clans, with a head of the tribe and head of the clan, offices which have become mere titles without power. The names of the clans are derived from trades or from famous forebears, for example, the *Kolompára* clan (bell-founders) and the *Simonado* clan, so called from a famous ancestor. Some names are totemic, as the *Makara* or 'fish' family and the *T'sarneštyi* or 'fowl' family. Each clan had its specific trade and characteristics. The *Patrinara* clan are horse dealers, a distinguished, proud people of deservedly high repute. The gypsies are very prolific. Ten to twelve children in a family are quite common and sometimes there may be so many as sixteen or eighteen. Marriage is by elopement; consent of the parents is given and the marriage feast held after the return from the unofficial honeymoon. It may also be a child marriage contracted by the parents, when the two fathers enter into a binding contract kneeling before a lighted candle. The bridegroom, often not six years old, leads the bride, aged about four years, to his father's house and they grow up together. Formerly, marriage was matrilocal, the man sometimes even changing his name, but now marriage is patrilocal, owing to the influence of Hungarian laws. Divorce was easy, and no great importance was attached to virginity. The death ritual shows the double influence of the desire to be free of the dead person and his spirit, and the celebration of a joyous occasion. Hence on one side the dedication of personal possessions and gifts to the dead, on the other the wake or funeral feast at which the young people are permitted considerable sexual freedom.

Cultural Change Among Shoshoni Indians

THE importance of human ecology among hunting and gathering peoples is emphasized by Julian H. Steward in a study of changes in Shoshonian Indian culture in the western United States (*Sci. Monthly*, 49, 6; December 1939). When Frémont crossed the Rocky Mountains in 1843 he recorded that the Indians of the semi-arid deserts exemplified humanity in its lowest form and its most elementary state. These Indians were Western Shoshoni, Northern Paiute and Southern Paiute, who lived as typical food-gatherers, "dispersed in single families, without fire-arms; eating seeds and insects; 'digging roots'". The mode of life of the Northern Shoshoni of eastern Idaho and western Wyoming, however, was in marked contrast. They were organized in large bands, hunted bison and fought their traditional enemies, the Blackfoot and Arapaho. This difference was brought about by an interaction of culture and environment which can be traced for over a thousand years. The Northern Shoshoni acquired the techniques for procuring food which made life possible in their environment, while the acquisition of the horse enabled them to exploit it to the full. Owing to the enlarged facilities in transport, food could be concentrated at a central point; and hence it was no longer necessary to live in small isolated family groups. Tribal groups were formed under chiefs or leaders, whose individual reputation might lead to the aggregation of large but not necessarily stable or long-enduring bands. Communal hunting expeditions with or without a hunting 'shaman', according to the nature of the game, were organized on a large scale and extending to considerable distances; while warlike activities for material gain or fame were practised. There was a no less fundamental change in material culture. Not only did they adopt arms and weapons suitable for warfare and hunting, but also the skin *tipi* took the place of the brush and pole shelter, and basketry for containers and utensils was replaced by rawhide, while their clothing was of dressed skins.

Bantu Lexicography

IN view of encouragement now being given to the development of a literature in certain of the Bantu languages, it is essential, the Rev. C. M. Doke has pointed out, that serious thought should be given to the provision of adequate linguistic studies including dictionaries (*Scientia*, 34, 1; 1940). After a review of existing material, the following principles of Bantu lexicography are suggested as among the essentials. (1) Alphabetical entry under the stem, without the prefix. (2) Derivative words should not have a separate entry, unless they have a special meaning not deducible from the plain function of their derivative formation. (3) Indications of the tone should be given, so far as possible, in all entries for those languages in which intonation is a significant feature. (4) Indication of the vowel-length should be given, especially in those Central Bantu languages where it is a semantic feature. (5) Phone values should be indicated where orthography is insufficient. (6) Idiomatic illustrations of the use of words should be included—of the utmost importance in any scientific dictionary. (7) Where dialectal variants are included the place of origin should be indicated. (8) Cognizance should be taken of a changing vocabulary. (9) Etymological and comparative material should be included so far as it can be afforded.

Orchis Tubercles

STUDY of the development of the tubercle of *Orchis mascula* I (B. C. Sharman, *J. Linn. Soc.*, 52; 1939) directs attention again to the peculiar capacity for growth possessed by localized parts of leaves and internodes in certain monocotyledons. In Orchis the uppermost axillary bud is carried away from the parent axis by the extension of the first two scale leaves of the axillary bud to form the sinker tube.

This extending tube includes, on the side next the parent, axial tissues of the region of bud insertion This construction is supported by anatomy, since the vascular strands of the foliar structures enclosing the tubercle bud run up the adaxial side of the sinker tube to connect with the vascular system of the parent axis. The main storage region of the tubercle is of the nature of a root, but is peculiar in being polystelic. This peculiarity is evidently associated with food storage, since after the period of swelling the distal part becomes monostelic. The tuberization of the bud is controlled by food supplies and may also be affected by fungal infection. The droppers of tulips are very similar but usually undergo greater extension and show less evidence of food storage

Calculation of Linkage

THE estimation of the crossing-over value is efficiently determined by the method of the product ratio (Fisher and Balmukand, 1928) To save much calculation of the ratio of the products of the cross-over classes to the products of the non-crossover classes in the F_2, W. L. Stevens (*J. Gen*, 39, 171 180, 1939) has provided tables for direct interpolation, from which the crossing-over value, accurate to the fifth decimal, may be obtained, together with the variance of the crossing-over value

Mineral Deposits of the Murchison Range

IN the eastern Transvaal a belt of basement rocks stretches from the escarpment in the west to the Kruger National Park in the east Certain quartzites in this belt form a series of hill-ranges to which the name 'Murchison Range' is given. In a memoir of the Geological Survey of South Africa just published (No 36, 1939, pp. 163 and coloured geological map) the mineral deposits of the belt are described by van Eeden, Kent, Brandt and Partridge An igneous complex, hitherto unsuspected, is described as consisting of hornblende-granite and a variety of gabbroic types. The remainder of the Murchison rocks are shown to be intensely altered acid and basic lavas with an intercalated group of sediments in which occur the quartzites and quartz-schists that have determined the topography and controlled the mineralization of the belt The whole schist belt, including the igneous complex, is invaded by the surrounding 'Old' granite, and the gold-bearing sulphide deposits of the belt are ascribed to hydrothermal processes related to the granite. The mineralization is predominantly of the arsenopyrite-pyrite-pyrrhotite type, except along a crush-zone, thirty-two miles long, known as the 'Antimony line'. Here, in addition to the normal minerals, a later suite of antimony minerals is also present. A number of minerals, of which emeralds are the most important, are associated with pegmatites The emeralds occur in biotite-schists adjacent to pegmatites. Among the later rocks attention is directed to the exceptional abundance of dolerite dykes of Karroo age which cut the granite and schist belt and occur in two well-defined sets, one parallel to the range (N. 55° E.), the other trending N. 30° E.

Seismological Data from India

THE recently inaugurated quarterly seismological bulletin of the Government of India Meteorological Department has just been received for the quarter October–December 1938. It has been published under the direction of Dr. S. K. Banerji and consists of the interpretations of seismograms obtained at Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad and Kodaikanal, all collected at Bombay, together with non-instrumental reports collected from voluntary observers by the meteorologist at Poona. The following numbers of earthquakes were registered: Agra 133, Colaba (Bombay) 103, Alipore (Calcutta) 115, Colombo 71, Dehra Dun 32, Nizamiah Observatory (Hyderabad) 72, and Kodaikanal 76. These numbers are probably not altogether indicative of the seismicity of the areas adjacent to the observatories named on account of the variation of the registering equipment Eleven earthquakes between the intensities 4 and 6 (Rossi–Forel scale) were recorded by the observers, those of greatest intensity being one at Gauhati, two at Dibrugarh and one at Kalat.

Tsunamis

THIS is the subject of a paper by B. Gutenberg (*Bull. Seis. Soc Amer*, 29, No 4, 517–526; October 1939) who cites eighteen publications including some due to F Montessus de Ballore, C. Davison and A. Imamura, and exhibits some original work of his own on the Atacama earthquake of November 11, 1922, in support of his hypothesis. This is that tsunamis ('tidal waves', 'maremotos') may be produced by submarine volcanic eruptions, submarine slides started by earthquakes, submarine faulting and atmospheric conditions At least some of the largest tsunamis have been produced by submarine slides, with earthquake waves as a trigger force. The macroseismic and microseismic data of the Atacama earthquake of November 11, 1922, indicate that the fault movement occurred inland; the tsunamis originated from a submarine slide near a relatively feebly shaken stretch of the coast where the surface slopes steeply to a considerable depth On gently sloping coasts, such as those of California, large tsunamis are rare and the relatively small tsunamis there are probably produced by faulting at the bottom of the ocean.

Hydrolysis of Proteins by Pepsin

LIGHT on the mechanism of hydrolysis of egg albumin by pepsin has been shed by A Tiselius and I.-B Eriksson-Quensel (*Biochem J.*, 33, 1752; 1939) using electrophoresis, sedimentation and diffusion methods A digestion mixture does not contain a number of products of continuously varying size and other properties but instead contains only unchanged large molecules and fully digested end products of molecular weight 1080 Pepsin is therefore assumed to attack one after the other of the protein molecules, breaking them down immediately to low molecular weight split products

Formation of Urea

THE accepted theories accounting for the formation of urea in the organism, namely, (1) the cyclic reaction from ornithine via citrulline and arginine to urea and thus back to ornithine, and (2) urea from glutamine and ammonia, are linked up by S. J. Bach (*Biochem J.*, 33, 1833; 1939) who, from results of experiments on liver by the tissue slice technique, puts forward two other possible mechanisms. These are: (3) urea synthesis from citrulline by oxidative hydrolysis; and (4) the possible oxidative conversion of ornithine and citrulline into glutamic acid and then glutamine and finally urea by the action of ammonia.

LONG-DISTANCE BROADCASTING

DURING the earliest years of the development of radio broadcasting in Great Britain, efforts were made to restrict the area over which reception was necessary, in order to build up a service giving speech and music reproduction of the highest quality It was with this object in mind that the regional scheme of broadcasting stations was developed. The country was divided up into sections or regions, each of which was served by two transmitters, one providing the national programme and the other a local or regional programme In this way the majority of listeners were provided with two programmes emanating from a broadcasting station within about one hundred miles, which was considered to be the limiting range at which a reliable service could be obtained free from interference or fading

The possibilities of long-distance broadcasting on a considerable scale were not generally admitted until about 1932; but since then, many millions of pounds have been spent by the several countries which have decided to establish wireless stations for this purpose. A review of the general development of such long-distance broadcasting was given by Sir Noel Ashbridge, Controller of Engineering of the British Broadcasting Corporation, in a Friday evening discourse at the Royal Institution on January 26

After summarizing very briefly the main facts accompanying the development of radio communication over hundreds and thousands of miles, Sir Noel pointed out that the short wave-lengths in the region of fifty metres offer the best possibilities of covering long distances, by reason of the comparative ease with which such radio waves travel through the ionosphere There are, however, many disadvantages and complications with short-wave transmission, which are not encountered in the use of medium waves over moderate distances For example, in order to attain anything in the nature of a reliable service, it is practically necessary to choose a special wave-length for each transmission, depending upon the geographical location of the sending and receiving stations, the time of day and season of year and the degree of sunspot activity on the surface of the sun.

Two advantages of the use of short wave-lengths are, first, that much less power is required to cover a given distance on account of the comparative ease of transmission through the ionosphere; and secondly, it is practicable to design antenna arrays and reflectors so as to concentrate the radiated energy into a sector or zone in the desired direction. The difference in local time must be taken into account when considering the areas where reception is required, so that it is not normally necessary to transmit in all directions simultaneously.

It will thus be realized that the only really practicable means of giving a broadcasting service to any distant continent is by means of short-wave transmitters using directional aerials, so designed as to cover by zones the countries to be served. These zones can then be supplied with programmes simultaneously, by using several transmitters together, or successively for shorter periods, using one or more transmitters which can be changed over from one directional aerial system to another at suitable times Provision must also be made for changes of wave-length to conform to the varying conditions of light and darkness, season and state of solar activity. It will be realized that in order to arrange for reception during the evening in all parts of the Empire, it is necessary to transmit almost continuously throughout the twenty-four hours.

After experimenting with a single transmitter as far back as 1927, the Daventry short-wave station was opened for service in December 1932, with two transmitters of 10–15 kilowatts in power, and five antenna systems directed towards Australia, India, South Africa, West Africa and Canada respectively. The width of beam varied with the direction of transmission, and provision was made for the necessary changes of wave-length in each case.

In order to develop the service to the greatest extent possible, systematic experimental work was conducted by the B.B.C with the view of improving the aerial systems, and in addition the co-operation of manufacturers was obtained to develop transmitters of considerably higher power than any hitherto available for short-wave radio communication The first improvement included the substitution of horizontal aerials for the vertical dipoles previously used, and also the arrangement of the whole antenna system with its reflector to project the radiation at a small angle above the horizontal so as to give the efficient reflection from the ionosphere in the desired direction

At the Daventry station, as it existed before the War, about thirty separate antenna arrays were provided, supported from twelve masts 500 ft. to 150 ft. in height, the whole covering a site area of about 160 acres. Additional transmitters with outputs varying from 50 to 100 kilowatts were also installed, and facilities are available for further additions. During this expansion and development, the introduction of foreign language broadcasting changed the character of the service somewhat, in so far as it became necessary to cater for world coverage instead of British Empire coverage only.

As a result of improvements on the above lines, a broadcasting service has been established on a permanent basis, giving large numbers of people great benefit by direct listening on short-wave broadcasting receivers In addition, however, the efficiency of the service has been increased in many colonies by the establishment of local relaying facilities, in which the signals from England are received on a high quality and somewhat elaborate central receiver, and relayed either by a separate medium wave broadcasting transmitter, or by line to subscribers connected to a central exchange.

From the engineering point of view, the main development described in Sir Noel's discourse has taken place in the astonishingly short period of five years It has been based on many years research by some of the world's most eminent scientific workers, followed by much patient work by engineers; and it is a matter of regret that temporarily many of the short-wave broadcasting services of the world have been directed to matters of international politics rather than to entertainment and the more peaceful type of informative programme for which they were intended.

R. L. S-R.

A NOTABLE METEOR

ON March 24, 1935, a bright meteor fell through the atmosphere, in a direction apparently not far from the vertical, over the Cheviots in Northumberland, about twenty miles south of Berwick. The day was a Sunday and at the time, about 7 p.m (G.M.T.), night was beginning to fall over England Probably because the sky was still too light, the meteor seems to have almost escaped notice in England: one observation is reported from Scarborough, and several adults and children saw it from Oldham, falling down as a vivid shooting star with a flaming tail From Holland, Denmark and southern Norway, however, where the twilight was almost ended, many observers saw either the meteor itself, or the bright train which it left behind it; this persisted for 20-30 minutes Prof C. Störmer (*Astrophysica Norvegica*, 5, 117–138; 1939), naturally with much help from others, has collected and discussed the observations, in order to determine the location of the meteor flight, and the height and other particulars concerning its train At first, of course, the train was straight, but it gradually became very deformed; this was possibly partly on account of its sinking downwards, but mainly because of air currents, almost horizontal, but evidently varying very much in direction at different heights along the original train. The rare cases, such as this, of persistent luminous trains of large meteors, provide one of our chief sources of information concerning the velocity and direction of the wind in the atmosphere above 70 km., the other sources being the still rarer luminous night clouds, and the infrequent remains of polar auroras.

The most definite data obtained by Prof. Störmer for the meteor of March 24, 1935, were provided from a photograph of the train, already much distorted, taken at Grouw, in Friesland, at about 7 10 p.m., and three pastel sketches (in colours) of the distorted train, made at 7.0, 7.10 and 7.20 p.m; these were made from a house in Stavanger, Norway. These sketches and the photograph were of special value because they showed an indented skyline (landscape or buildings) which enabled the azimuth of the meteor from Stavanger and Grouw to be determined afterwards (though with considerable labour) Other photographs showed the train as a spectacle, but contained no means of determining its azimuth so definitely.

The points Stavanger and Grouw together with the meteor train itself made an almost equilateral triangle of approximately 400 miles side. Yet from that distance the twisted trail as seen from Stavanger shone against the sky background with sharp outlines, and had the same colour and intensity as the moon The light was steady, like electric light, and did not at all resemble the northern lights. It became increasingly distorted and at the same time it broadened and faded. By 7.30 p.m. (G.M T) it had entirely disappeared It seemed to remain in the same spot all the time.

Prof Störmer found that the top and bottom of the train were respectively about 60 and 50 miles above the ground, and that until about 7.30 p.m. it lay above the earth's shadow, so that it was illuminated by the sunlight; he concludes that the intense yellow colour of the train was due to this illumination.

As regards the meteor itself, it appears to have descended to a height of about 40 miles or less, and finally exploded with an intensely white light: the lowest part of its trail disappeared almost instantaneously The meteor was said to have moved slowly like a rocket, its time of passage being about 5 seconds. As regards the colour of the train, one report gives it as fiery-red, another as red-yellow.

Prof. Störmer's discussion of this meteor and train is illustrated by plates showing the sketches and photographs.

ANCIENT WALL-PAINTING IN SOUTHERN INDIA

AN investigation has been conducted by S. Paramasivan, archæological chemist of the Government Museum, Madras, with the view of determining the technical methods employed in the wall paintings of the Kailasanatha and Vaikunthaperumal temples of Conjeevaram, the ancient Pallava capital, and in the Bagh caves of the Vindhya Hills, Gwalior State. The last named paintings, though much mutilated and stained, still constitute "a priceless treasure comparable to those at Ajanta" (*Proc. Ind. Acad. Sci.*, 10, Section A, No. 2; 1939. See also NATURE, 142, 757 and 143, 554).

KAILASANATHA AND VAIKUNTHAPERUMAL TEMPLE PAINTINGS

The Kailasanatha paintings date from the seventh–eighth centuries A.D., and are on the inner walls of narrow cells lining the outer courtyard, depicting scenes from Hindu mythology. Those of the Vaikunthaperumal temple, erected by Nandivarman II (A.D. 725–790), probably date from the eighth–ninth century. They have all disappeared with the exception of a single head; but there are traces of paint everywhere.

The Pallava paintings are of the classical or Ajanta style of Hindu art. The subjects of the investigation were the carrier, the ground, the pigments and the binding medium.

Carrier. The inner walls serving as the mechanical foundation of the paintings directly supporting the ground are of sandstone, the rough surface holding the plaster fast.

Ground. Microsections showed two lines of cleavage separating three layers, (1) rough plaster, (2) fine

plaster, (3) paint. Though paint and fine plaster could be separated with a sharp pin, no separation could be effected between fine and rough plaster. The respective thicknesses were. painted stucco, 2·1–4·7 mm ; rough plaster, 1·5–4·1 mm. ; fine plaster, 0·3 mm. ; paint, 0·3 mm

By analysis it was determined that the fine plaster is a lime-wash, while the rough plaster is composed of lime and sand, the latter serving merely as inert material A pure rich lime having no hydraulic properties has been used. No organic binding material, gum or glue, had been added. The strong binding of the two layers indicated that the lime-wash had been laid on while the rough plaster was still wet.

Pigments These were yellow ochre, red ochre, terre verte, carbon, lime—the limited number being due probably to the desirability of avoiding pigments containing alkalis, and secondly, the limitations of local supply.

Binding Medium. There was no water-soluble binding medium nor drying oil, glue, albumin or casein in the paint The technique is one of lime medium, but owing to the nature of the pigment, gum had been added to the black.

The Bagh Caves

Owing to the weight of the superimposed band of claystone, the walls of the sandstone caves, once completely covered with paintings, have crumbled badly Percolating moisture has also damaged the paintings. They probably date from the early seventh century A.D. Like the Ajanta paintings they belong to the Golden Age of Indian classical art.

Carrier The sandstone walls were left rough to hold the plaster wall, but the percolation of water has softened the plaster, while the white efflorescence on several of the paintings indicates the presence of gypsum, sodium sulphate, magnesium sulphate, etc. This efflorescence is not due to salts in the plaster, as is clearly indicated by analysis

Ground. Three forms of plaster were used : a deep red ferruginous earth, a light red ferruginous earth, and a rough plaster of lime. Microsections here revealed three lines of cleavage in the earth stuccoes, and two in the lime, indicating four and three layers respectively. They were composed of paint, a white material serving as fine plaster, and two layers of rough plaster in the earth stucco, but one only in the lime stucco. The thicknesses were as follows. Earth stuccoes. rough plaster (1) 6·8–19·9 mm., (2) 1·0 mm. ; fine plaster, 0·1 mm. ; paint, 0·1 mm. ; lime stucco : rough plaster, 3·4–6·5 mm. ; fine plaster, 0 2 mm. ; paint, 0·2 mm. The earth stuccoes are very much thicker than those of lime, while the paint film in the latter is twice as thick as that on the earth stucco and shows a certain lack of delicacy in the handling of the brush It is probable, therefore, that the lime stucco does not belong to the palmy days of Bagh, or that the paintings on lime and earth stuccoes were the work of different groups of artists.

The fine plaster was a mixture of lime and calcium sulphate which had been applied to the surface of the rough plaster to serve as a fine plaster ; but in the lime stucco the fine plaster showed no trace of calcium sulphate.

Thus the ground was prepared from naturally occurring ferruginous earth, or of artificially prepared lime plaster. The principal components of the earth plaster are silica, iron, alumina and lime, while of the lime plaster they are lime and silica. The plasters, in addition to their natural binding qualities, have been reinforced by vegetable fibres in the lime plaster in considerable quantities.

Pigments. The following pigments were identified : yellow ochre, red ochre, terre verte, lapis lazuli, carbon, lime. The colour scale is limited and evidently conditioned by local supplies.

Binding medium. No gum could be extracted by water, nor was the presence of any vehicle or organic binding medium in the paint film detected by various tests applied ; but acid green indicated the presence of glue Thus a tempera technique had been employed ; but on all the paintings on plaster collected, treatment with hydrochloric acid gave a characteristic calcium reaction indicating a lime medium technique, and not a true fresco technique. The black paint gave the usual stain for glue to acid green.

THE BRITISH PHARMACOPŒIA

Proposed Innovations

IMPORTANT changes in the "British Pharmacopœia" are foreshadowed by reports of committees, appointed by the Pharmacopœia Commission, which have now been published by authority of the General Medical Council and are obtainable at the offices of the Council, 44 Hallam Street, London, W.1.

The most striking of the recommendations of the Advisory Committee in Pharmacy and Pharmacognosy are those which propose the inclusion in the next "Pharmacopœia", due to appear in 1941, of a large number of formulæ for medicinal preparations. These are quite distinct from the galenical products, such as tinctures, extracts and infusions of vegetable drugs, which always occupy an important part of pharmacopœias and from which medical practitioners build up their prescriptions. The object of the inclusion of these formulæ is to furnish medical practitioners with a choice of ready-made prescriptions which have been tested by laboratory and clinical experience. Prescriptions are included for compound digitalis pills, compound bismuth powder, cod liver oil emulsion, methyl salicylate liniment, calamine lotion, tannic acid jelly, acriflavine lotion and calcium gluconate injection, among some thirty proposed new monographs of the character of ready-to-use medicines.

It is understood that the Pharmacopœia Commission regards this innovation favourably, and there is no doubt that it is one which would be welcomed by the large body of general practitioners. The inclusion of these recipes in the "Pharmacopœia" would set up official standards with which the preparations would have to comply ; thus a doctor prescribing, say, "Pulv. Bismuthi Co. B.P.", would have the

satisfaction of knowing that the medicine supplied to his patient would be the same, wherever it was dispensed.

The Committee which was appointed to advise the Pharmacopœia Commission on the standardization of tablets has not as yet reached conclusions. Its report states that the possibility of defining tablets in the "British Pharmacopœia" has been explored and the general principles to be adopted have been worked out, but while good progress has been made towards the establishment of standards for composition, size and weight of a range of tablets in frequent use and the question of a test for disintegration has been investigated, further research is necessary before definite recommendations can be made. It is hoped, and expected, that an acceptable test for the rate of disintegration of tablets will be forthcoming before the next "Pharmacopœia" goes to press; the need for one was clearly shown in papers read at the last meeting of the British Pharmaceutical Conference

A curious recommendation is made to the Pharmacopœia Commission by the Committee on Pharmacy and Pharmacognosy as a test for the pungency of tincture of capsicum. It is that 3 millilitres of a solution of stated dilution "swallowed all at once produces a distinct sensation of pungency in the throats of at least two out of three individuals". Possibly the criticism will be made that this is more like a test for throats than a test for capsicum.

PETROLOGY OF EAST GREENLAND

By DR. L. HAWKES
BEDFORD COLLEGE, LONDON

THIRTY years ago it might have been thought that the main forms of intrusive bodies in the North Atlantic Tertiary volcanic province were known. Then came the discovery by the Geological Survey of the cone-sheet and ring-dyke complexes, and now in a part of East Greenland very difficult of access Mr. L. R. Wager has had the good fortune to find, and, in association with Dr W. A. Deer, the pluck and persistence to investigate, an intrusive mass which in form, composition and internal structure is unlike any hitherto known in the province The work in the field and laboratory has been very thorough, and the results are now presented in a handsomely produced memoir which will be of absorbing interest to students of igneous rocks and doubtless a basis of lively discussion among them*

The Skaergaard intrusive is finely exposed in a mountainous region, but as is so commonly the case with large intrusives, the original rock cover has been removed by erosion and the base is not seen. The mass narrows downwards and the 2,700 metres of its exposed thickness is interpreted as the upper part of an inverted cone some seven kilometres in diameter at its base and tilted 40° from the vertical—it belongs to the class of 'funnel intrusions'. The pre-existing rock displaced by the intrusion must have been forced upwards, and that without appreciable disturbance of the neighbouring rock. The authors suggest that the expulsion of this huge mass was a sudden act, and that the cover was shattered by expanding gases and strewn far and wide. Rather mysterious is the way in which an extensive gabbro sill, believed to have been enclosed within the cover, has become disembodied, to lie within the intrusive. Whatever the mechanism of emplacement, there came into being within the upper part of the earth's crust a volume of magma enclosed—to use Prof. Tilley's apt phrase—in a gigantic natural closed crucible, and the cooling of this perhaps unusually fluid melt proceeding under tranquil conditions has provided a remarkable demonstration of the course of differentiation in a basic magma.

Solidification first took place at the sides and top of the 'crucible' and then, more slowly, crystallization continued in the main mass within to give a series of rock layers likened to a pile of saucers, many of the layers being distinguished by a preponderance of dark minerals at their bases This layering is so prominent that on first seeing the Skaergaard region from a ship, Mr Wager surmised the rocks to be massively bedded sandstones Any hypothesis of successive intrusion seems to be ruled out, and the solid mass is believed to have grown from below upwards, largely by accumulation of crystals carried down by convection currents. This postulated upward course of solidification is strongly supported by the nature of the minerals: with increasing height in the intrusive, the olivines, pyroxenes and felspars show a gradual passage from higher to lower temperature species

The original magma, as deduced from the chilled border rocks, was of basaltic composition, and very little change in silica content is shown by the majority of the successive rocks formed, but they become unusually rich in ferrous iron, and ferro-gabbros are described composed essentially of pyroxene, plagioclase, fayalite and some quartz. Then finally and abruptly a relatively small amount of acid granophyre resulted. Notwithstanding the extreme rarity in the earth's crust of rocks of ferro-gabbro composition, the authors hold that the course of differentiation here followed is the normal one for a basic magma. But the 'crucible' was not a platinum one. Its lower part was of acid gneiss, and the magma has reacted with inclusions of granophyre. These inclusions are considered to be altered gneiss, although—somewhat strangely perhaps—the passage of gneiss to granophyre seems not to have been observed either in the wall rocks or in the inclusions. To this 'contamination' of the magma the emergence of part at least of the final acid granophyre differentiate is ascribed, and the authors subscribe to the view, now steadily gaining ground, that the normal calc-alkaline series of igneous rocks is not derived from the straight forward differentiation of a basic magma but results from the incorporation within that magma of acidic material. If this is accepted, the large granophyre intrusions of Skye and elsewhere in the province must owe their origin to the fusion of acid gneiss or crustal sialic rocks of like composition: this, however, is still a controversial matter.

* Geological Investigations in East Greenland, Part 3. The Petrology of the Skaergaard Intrusion, Kangerdlugssuaq, East Greenland. By L. R. Wager and W. A. Deer. *Meddelelser om Grønland*, 105, Nr 4.

SEVENTY YEARS AGO

NATURE, vol. 1, February 3, 1870

Catching Cold

PROF. SYMES THOMPSON, Gresham professor of medicine, in one of his Gresham lectures discussed the cause of the common cold After describing the cavities concerned, he pointed out that "the ordinary cold is simply, in the first instance, congestion of the warm, moist, blood-charged membrane, which lines all these cavities and is continuous throughout the series of them . . . This congestion is apt to pass on, under unfavourable circumstances, to inflammation, and to consequent derangement of structure. The congestion merely means that more blood is thrust upon, and retained in, the minute channels and vessels of the membrane, than those channels can healthily accommodate. The first cause of this forced engorgement is that cold is extensively applied to the internal skin, which then, under the constringing and contracting influence, drives its own blood out, partly into those surcharged tracts of mucous membrane The injurious effect known as 'cold' is now sure to be realised if this external chill is experienced when the general system is weakened by exhaustion."

Once a cold has been "caught", Prof. Thompson says that vigorous circulation of the blood in the skin should be restored, preferably by a Turkish bath, "reinforced by the administration of stimulants, first and foremost amongst which stands concentrated food. Indeed, the Professor's pet stimulant seems to be 'Whitehead's Solid Essence of Beef'. . . . This preparation differs from Liebig's Extract of Meat chiefly in containing the gelatinous as well as the fibrinous constituents of the flesh . . . The Gresham professor scattered the little round cakes, out of neat half-pound cases, liberally to his audience, recommending them to begin at once to fortify themselves against the inclement atmospheric influences".

Deep Mining for Coal

MR. EDWARD HULL, F.R.S., director of the Geological Survey of Ireland, read a paper before the Royal Society on the temperature of the strata taken during the sinking of the Rose Bridge Colliery, Wigan, in 1868–69 This mine was 808 yards deep, "is the deepest in the world" and the temperature at the bottom was 93½° It may be regarded, it is said, as an experiment towards a solution of the question of very deep mining and has "an especial interest for those who concern themselves about our supplies of coal".

"IT is no secret that the present régime at the Observatory of Paris has been rather more autocratic than could be patiently endured, even in a country subjected to eighteen years of personal government Matters have at length reached a crisis, and the Minister of Public Instruction is placed in the awkward position of having to dismiss from the public service one of the most eminent of modern astronomers, or accept the resignation of the whole of the rest of the staff of the Observatory." [The Director was M. Le Verrier.]

BEFORE a meeting of the Berlin Chemical Society, Prof. Rose reported on the first diamond to be found in Europe. A small diamond had recently been found in Bohemia, in which garnets, hyacinths and sapphires had been found for years.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned

PART-TIME SPEECH THERAPIST in the Psychiatric and Child Guidance Clinic—The Secretary-Superintendent, Addenbrooke's Hospital, Cambridge (February 10)

A LECTURER and a SENIOR LECTURER in the Department of Mathematics in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W C.1 (March 1)

ENGINEER for the Public Works Department of the Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, S W.1 (quoting M/8993)

TEMPORARY METEOROLOGICAL ASSISTANTS (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B (Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

EXAMINERS in the General Engineering and W/T and Instrument Branches of the Aeronautical Inspection Directorate—The Inspector-in-Charge, A.I.D. Training School (I.C.S /Rec 52), Brandon Steep, Bristol 1 (on Form 786)

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The Manchester Museum The University of Manchester, Museum Publication 116 Report of the Museum Committee for the Year 1938-39, Pp 32 (Manchester, Manchester Museum) 6*d*. net [111

Association of Special Libraries and Information Bureaux. Report of Proceedings of the Sixteenth Conference organised to be held at Nottingham University College, September 15th to 18th, 1939. Pp. 92. (London Association of Special Libraries and Information Bureaux) 5*s* [161

Stonyhurst College Observatory Results of Geophysical and Solar Observations, 1938, with Report and Notes of the Director, Rev. J. P. Rowland Pp xix+40 (Blackburn Stonyhurst College Observatory) [161

The *Chemist and Druggist* Year-Book, 1940. Pp. 355+Diary (London The *Chemist and Druggist*) [161

Transactions of the Royal Society of Edinburgh. Vol 60, Part 1, No 2 Cyclic Variations in the Vascular Architecture of the Uterus of the Guinea Pig By Dr P Bacsich and Dr G M. Wyburn. Pp. 79–86+2 plates (Edinburgh Robert Grant and Son, Ltd., London: Williams and Norgate, Ltd.) 1*s*. 9*d* [181

A List of Books suitable for a School Science Library. Pp. 88. (London Science Masters' Association) 1*s* 2*d* [221

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe Rédigé par Sir D'Arcy Wentworth Thompson Vol 27, pour l'année 1937 Pp. xxxiv+50. (Copenhague Andr. Fred. Høst et fils) 3 00 kr [101

Bulletin of the Bingham Oceanographic Collection. Vol. 6, Art. 7: Quantitative Observations on the Pelagic Sargassum Vegetation of the Western North Atlantic, with Preliminary Discussion of Morphology and Relationships. By Albert Eide Parr Pp. 94 Vol 7, Art. 1: Acoel and Polyclad Turbellaria from Bermuda and the Sargassum. By Libbie H Hyman. Pp 26+9 plates. Vol. 7, Art. 2: Young Caranx in the Western North Atlantic. By J T Nichols Pp. 10. (New Haven, Conn.: Yale University.) [161

U S Department of Agriculture. Circular No 530. The Vegetable Weevil. By M. M. High. Pp. 26 5 cents. Leaflet No. 192. Centipedes and Millipedes in the House. By E. A. Back Pp 6. 5 cents (Washington, D C. Government Printing Office.) [161

Bulletin of the Geological Department, Hebrew University, Jerusalem Vol 2, Nos 3-4 Outline on the Tectonics of the Earth, with Special Reference upon Africa. By Leo Picard. Pp 66. (Jerusalem Hebrew University) [161

Egyptian University. Faculty of Science. Prospectus for the Academic Year 1937–1938. Pp iii+60. Prospectus for the Academic Year 1938–1939. Pp. iii+68 Publication No. 3. Cucurbitaceae in Egypt. By Mohammed Hassib Pp. x+178 (Cairo: Government Press) [161

South Australia. Department of Mines. Mining Review for the Half-Year ended 30th June 1939 (No 70.) Pp 92+4 plates. Geological Survey of South Australia, Bulletin No. 18: The Pre-Cambrian-Cambrian Succession; the General and Economic Geology of these Systems, in portions of South Australia By Ralph W. Segnit. Pp. 192+11 plates. (Adelaide: Government Printer.) [221

Fondation Universitaire. Dix-neuvième Rapport annuel, 1938–1939 Pp. xvi+166. (Bruxelles Fondation Universitaire.) [221

Annuaire pour l'an 1940 Publié par le Bureau des Longitudes. Avec des notices scientifiques. Pp. viii+550+A16+B26+C54. (Paris: Gauthier-Villars.) 25 francs. [221

Handbook and Directory of the United States Office of Education, 1939. Pp. ii+26. (Washington, D.C.: Government Printing Office.) [221

Malta. Annual Report of the Working of the Museum Department during 1938–39. Pp. xxviii. (Malta: Government Printing Office.) [221

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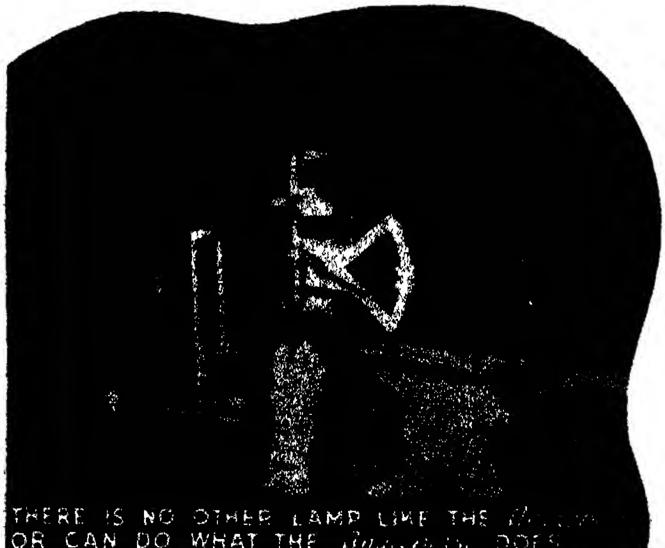

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PRESENT-DAY PROBLEMS OF YOUTH

SOME weeks ago, the National Youth Committee set up by the Board of Education announced that the Government had no intention of allowing a recurrence of the social problems of the War of 1914–18. Despite this assurance, familiar youth problems have again presented themselves and new ones have been created. A number of these were probably inevitable; others could probably have been avoided. It is not easy to resist the conclusion that, in certain important matters, the Government departments concerned with the social services have shown themselves to be regrettably lacking in foresight.

Nor is it easy to resist the further conclusion that some of them are exhibiting very little alacrity, method or determination in dealing with problems which appear to many to be urgent. Doubt on this point may be permissible, for it is probable that their hands are being tied by the Treasury, through reduction in financial assistance. But it might not have arisen at all, if these departments had shown more frankness in their pronouncements. Nothing is more likely to stiffen the task of the Director of Home Publicity at the Ministry of Information—that of making public opinion receptive to political decisions—than an accumulation of unanswered or half-answered queries on such matters.

If bewilderment is produced in this way, further psychological difficulties are created. In some cases, formidable resentment is built up; in others, apathy becomes all-pervasive. During recent weeks, both these reactions have been exhibited plainly; and nowhere more clearly than among those concerned directly and indirectly with problems of juvenile employment. In their treatment of a number of these problems, some departments seem lately to have displayed neither frankness nor wisdom.

Why, for example, has the Home Office had to undertake to consider applications for exemption from those sections of the Factories Act of 1937 which regulate the hours of work of juveniles? Surely the evidence collected during the War of 1914–18 by the Health of Munition Workers' Committee suggested strongly that even the regulations of the Act of 1937 were not entirely adequate? It is not to be doubted that the factory inspectors of the Home Office will use their new powers with great discretion, but it is more than likely that some of them will feel compelled at times to declare decisions which they will reach with considerable reluctance. From various parts of the country it is already reported that two of the most evil consequences of unsuitable working hours—listlessness and loss of 'further education'—have once more manifested themselves. In his recent King George Jubilee Trust report, "The Needs of Youth", Dr A. E. Morgan remarked, "British industry will not be ruined by being deprived of the privilege to exploit half-educated boys and girls". This pungent comment is as true in wartime as it is in times of peace. Even in factories which retain their pre-war time-tables, the *tempo* of production is apparently increased sometimes to such a pitch that the physical and psychological state of the slower workers is seriously affected.

Has the Home Office decided, in the face of all the evidence available on this subject, to surrender to the Ministry of Supply? If the outlook indicated by this ruling is maintained, what will be the quality of Britain's democracy at the end of the present conflict? For some workers, possibly even for the younger ones, patriotism may provide an

additional incentive; but, as Dr. H. M Vernon reminded his hearers at a meeting reported in NATURE of February 3, p 174, "Nature cannot be defied indefinitely"

Again, why has the Ministry of Labour permitted the suspension of certain of the vocational guidance and after-care activities of its Juvenile Advisory Committees? Why has the Ministry's scheme for the transference of young workers apparently ceased to function, while the need for it continues? And why have some at least of its hostels for these boys and girls closed their doors? Even when allowance is made for difficulties created by evacuation, such actions are bound to perplex those who had been led to believe that the Ministry took a broad view of its responsibilities towards young people It is perhaps significant that its war-time opinions on vocational guidance and after-care have not been accepted without question by other experts Its advice has been ignored by many local education authorities who have juvenile employment officers of their own and in whose districts the Ministry is only in indirect command. The very fact that acute disagreement exists here suggests that the Ministry's case for curtailing its activities is by no means unarguable. The 'rebels' are unquestionably right in maintaining that, both from the point of view of the individual, who needs a congenial occupation if he is to exert himself fully, and from the point of view of the nation, which urgently requires efficient workers, sound vocational guidance is at least as necessary now as it was before the War If the Ministry feels unable to continue this branch of its work, it might well ask local authorities whether they will take it over The machinery for such a transfer already exists

Furthermore, why have the Civil Service Commissioners had to suspend their normal examinations for entry to this Service? A very considerable number of able boys and girls—and their parents and teachers—have lately been profoundly disturbed by the Commissioners' unexplained move In all parts of the country, secondary school principals, who are in a good position to judge the public reaction to it, are voicing strong criticisms of the Government's attitude to this problem. It is understood that alternative proposals, put forward by the staff side of the National Whitley Council, are being considered Consideration of them should be completed speedily and positively. Purely negative decrees on employment matters by the Government can scarcely be held to provide good examples for private employers; nor can they easily produce the occupational incentives which are so much needed by young people at the present time.

Indeed, the negative character of the official attitude to many employment matters is extremely disconcerting. No reasonable person would expect the Government to show unerring foresight in making plans for dealing with situations which might never arise But there is, unfortunately, much evidence which suggests a marked lack of constructive and co-ordinated thought A striking example is to be found in the astonishing absence—an almost total absence—of official comment on what has been called the "16 to 20" problem

Lord Derby has suggested that voluntary labour camps should be provided for boys of secondary education who fall within this age-range. His proposal has been discussed at length in the correspondence columns of *The Times*. It is doubtful whether the space devoted to it has been commensurate with the usefulness of the suggestions put forward, or, indeed, with their relevance, for most of them—not unnaturally, perhaps—have been concerned primarily with the comparatively limited problem of the boy whose parents have been able to send him to a public school The Ministry of Labour's contribution to the discussion —communicated through *The Times* Labour Correspondent—has been a statement of the conditions under which boys in this age-group may be admitted to its ordinary technical training centres Is it surprising that the head master of a large south of England secondary school reports that his boys are "simply bewildered" about their futures?

Could not the Ministry of Labour at least stress frankly the need for considering the post-War effects of such schemes as those proposed by Lord Derby and his supporters? They certainly need consideration, for many of the suggestions seem to have been based on false assumptions One is that many boys in the 16–20 group have sufficient money and influence to enable them to make an entirely fresh occupational start after the War and therefore need not worry if, in the period prior to their military service, they are called on to do something which bears little relation either to their abilities or to their interests Another is that, when the War is over, the national recovery will not be hindered by the presence in the community of large numbers of middle-class young men devoid of occupational training and experience suitable

to their talents and temperaments. The vast majority of those leaving secondary schools cannot afford, even in war-time, to be ushered silently into unsuitable 'stop-gap' occupations, nor can the nation afford it. It is clearly important that these youths should be regarded, not as unfortunate liabilities to be put temporarily into places where they will create a minimum of trouble, but as citizens-in-training The head master of Winchester College, who is chairman of the Head Masters' Conference, has very properly insisted that, in any work scheme produced for the 16–20's, the opportunities offered should be *real*.

Is it too late to suggest that this problem should be tackled experimentally by the Ministry and the Board of Education? Individual head masters here and there are doing this in their own way, and according to their own ideas for example, by providing special commercial courses for senior boys who would normally have entered clerical occupations this year but have been unable to do so, and by increasing the amount of time devoted to O.T.C. activities. The Board of Education has already dealt with one of its own difficulties by allowing non-graduate students to enter its teachers' training colleges at the age of seventeen The Y.M.C.A. has proposed the formation of a Boys' Land Army. A number of professional training organizations have begun to provide shortened courses of instruction. One well-known rubber company has announced its intention of awarding a certain number of 'scholarships', providing free training and maintenance grants, to boys between the ages of 17½ and 19. Could not these experiments be co-ordinated and extended? If this were done, a great deal of the resentment and apathy noticeable at present might rapidly be dissipated and much valuable data might be gathered But it will have little worth if it be not done seriously and with a determination to act on the results obtained The adoption of an experimental approach, which might well make use of psychological techniques of vocational guidance and selection, must not be made an excuse for shelving decisions by bestowing semi-official blessing and inadequate funds on ardent advocates of reform, in the hope that the problem will quickly lose its urgency by the absorption of young men into the Fighting Services. An appropriate first step would be the appointment, by the departments concerned, of a director of research.

SCIENCE FOR A NEW AUDIENCE

Science and Everyday Life
By Prof. J. B. S. Haldane. Pp. 284 (London: Lawrence and Wishart, Ltd, 1939.) 5s net

THOSE who subscribe to the *Daily Worker* are privileged to read every week some of the most successful expositions of popular science in contemporary journalism It is not possible to discuss the implications of this fact in a brief review; but if Prof Haldane's modesty would permit him to admit that he is both a first-class man of science and a first-class educator, his faith would make him insist that he would be neither were he not a first-class Marxist This collection of articles is certainly as political as it is scientific, and its author would believe it less scientific if it were less political.

The book should be read not only by the general public but also by all those who aspire to make science intelligible to the general public. To these the author's technique will be a liberal—as well as a Marxist—education. Why is it so successful? Apart from the blustering, ozone-laden style through which Haldane introduces himself to his readers, rather as the *homme moyen sensuel* than as the ascetic scientist, there is the picture which he seems to carry in his eye of what his reader is like. He does not write for readers in their capacity of consumers willing to fill a leisure hour with science gossip, but rather as producers into whose labours science has already entered at every point. He creates a synthesis between the theories of scientists and the actions of workers, miners, chemical manufacturers, barmen, who are applied scientists by virtue of economic necessity. He does not describe disease as an abstraction but shows it always to be occupational, a function of the social environment.

Above all, the politician in him prevents Prof. Haldane from committing the commonest error of men of science trying to write for the man in the street, namely that emotion, or personal equation, is as deadly then as in the writing of a monograph for the *Philosophical Transactions*. He believes that the voice of honest indignation is the voice of science and so he writes.

Occasionally Prof Haldane permits himself the luxury of statements that, taken at face value, could no doubt be challenged For example, he says that "By postponing marriages, the Means Test not only causes unhappiness; but actual mental defect" It is improbable that Prof Haldane could produce evidence that the means test has actually increased mongoloid imbecility, but then he would point out that the only sort of person likely to take him up on such a point would be "Reactionary biologists" some of whom think "that the unemployed should be sterilized"

Two passages especially suggest how far we have gone since the day when popular science catered chiefly for ladies who sought a change from fancy sewing. The first is where Prof Haldane sums up against astrologers in Sunday papers: There is no righteous indignation, astrology is not an insult to that abstraction, scientific truth, "Astrologers and palmists are very useful to the cause of capitalism They help to persuade people that their destinies are outside their control . If enough people learn how the joint fate of us all can be altered, things begin to happen which mean the end of capitalism as well as of astrology and palmistry".

The other passage gives a significant criterion for judging between cause and cause. "We are quite right," Prof. Haldane points out, "to emphasize the environmental factors in tuberculosis just because we can control them We say that a house caught fire because someone threw down a cigarette end, and not because there is 21 per cent of oxygen in the air". Implicit here is the doctrine that the duty of the scientist is not to explain the world but to alter the world, and implicit on every page of the book is the author's belief that his duty as an educator is not to help his readers simply to understand phenomena but to become the *primum mobile* of their evolution.

JOHN LANGDON-DAVIES.

CHEMISTRY OF ORGANIC COMPOUNDS

(1) Ausführliches Lehrbuch der organischen Chemie
Von Wilh Schlenk Band 2 Pp xvii + 896 (Wien und Leipzig Franz Deuticke, 1939.) 30 gold marks

(2) The Chemistry of Organic Compounds
A Year's Course in Organic Chemistry By Prof. James Bryant Conant. Revised with the assistance of Dr. Max Tishler Pp. x + 658 (New York: The Macmillan Company, 1939) 18s net

(3) Introduction to Practical Organic Chemistry
By Dr Frederick George Mann and Dr Bernard Charles Saunders Pp ix + 191 (London, New York and Toronto Longmans, Green and Co., Ltd, 1939) 4s 6d

THE three books under review are so closely related to modern organic chemistry that they are conveniently taken together. They represent in a very marked manner the kind of organic chemistry which the young man of the present day, and perhaps for the next twenty-five years, will have to learn if he desires either to make the subject his life-study or intends to use it merely as a stepping stone to other walks of life

(1) The reputation of Prof. Wilh. Schlenk as a writer and teacher was established when Vol 1 of the text-book was published. The appearance of Vol. 2 enhances that reputation. To an earlier generation the two volumes must show a striking resemblance to that wonderful treatise started by Victor Meyer and Jacobson, the first volume of which appeared before Victor Meyer's death but which was finished later by Jacobson and others It was the first volume that contained both knowledge and wisdom and showed that even a book on organic chemistry could be made readable and interesting to the lay mind. The book contained such a wealth of knowledge expressed in such beautiful phrasing that it is doubtful whether we shall ever see its like again

Vol 2 of Schlenk's book, in general treatment and in power of expression, follows, with Vol. 1, as commendable modern equivalents of the first volume of Meyer and Jacobson. Like Victor Meyer's book, it is no mere record of an endless number of compounds, but deals only with such substances or group of substances as lead to or enforce the establishment of some theoretical point of value in the discussion of some principle underlying the science. The discussions on these points are by a master mind and make excellent reading. They give the book an interest unusual in a scientific text-book. According to the short preface the author intends to publish a Vol. 3 to complete the issue. If the third volume is as good as the other two, the whole work will form a striking addition to our chemical literature. There is, of course, the difficulty of language for the English reader, a difficulty which is not overcome

by a translation, if such were possible nowadays. The true charm of the book lies in the expression in the German language of the enthusiasm of a man who loves his subject and is prepared to give all he possesses in unstinted measure to those who can appreciate the gift An English translation would be but a dead-sea apple and turn to dust and ashes in the mouth It would be lifeless Despite present circumstances, we must place a mastery of the German language in the forefront of our educational schedule The Germans as scientific people rank high and we should be curiously handicapped if we failed to understand or to appreciate any new discovery they might make, the lack of a knowledge of which might stand us in ill-stead

The free interchange of knowledge as it was say forty years ago, no longer exists. Many things have caused the change, notably the supposed need for commercial secrecy. It is true that many firms permit publication by their employees, provided all requirements of the patent laws have previously been met. This involves, usually, some little delay, but can scarcely be regarded as a hardship. Other firms, unfortunately, do not grant such privileges, and much useful and perhaps essential knowledge is buried in their archives Team work in industry has come to stay because it is by far the best means of attacking a general problem, and although the team worker is individually the loser by sharing any new discovery with others, it is made up to him in other ways and the new discoveries can be published by the firm under the names of the team-workers concerned For it is essential that new knowledge should be published, annotated and recorded, otherwise progress will be impossible One can scarcely realize what the present position of knowledge would be had the research workers of the past evaded the path of free publication Nevertheless, with good will and co-operation between industrialist and scientist, the terms being used merely to denote two different types of scientist, all will be possible and the goal reached by which all new knowledge will be annotated and pigeonholed for the benefit of succeeding generations.

Let us, for example, be certain that a book like Schlenk's is full and unrestricted and that nothing is held back either by reasons of commercial exigencies or for any cause whatever. It is surely in the interests of industry itself that there should be unrestricted publication of all new knowledge, for it is unthinkable that new knowledge can be discovered if any industry buries the information it has gained on account of some real or supposed desire to prevent a competitor from taking advantage of it. By burying its knowledge, a firm reaps no real benefit but injures itself by checking the advance of knowledge in other branches of the subject with which it deals. The research worker is thereby prevented from knowing what has been discovered, the progress of discovery is inhibited and the direction on which all true progress depends is lacking

(2) President Conant is a great administrator, and his power as an author has been shown in many ways, notably by his publication of organic syntheses and by the first edition of the book under review. The revised edition is published after six years with the assistance of Dr. Max Tishler, research chemist at Mercks. The new matter deals mainly with the advances made in that region which lies between abstract organic chemistry and biology, because it is undoubtedly along the lines of organo-physiology and organo-pathology that discoveries of vital importance to mankind will be made.

It is doubtful whether we shall succeed in discovering the true chemistry of life, but we shall get sufficiently near to that discovery to enable us to prepare biological substances the lack of which in the human system leads to disease and death It is perhaps impossible to renew the worn-out human machinery but by the application of essential organic compounds, which the ageing system fails to produce, it will be possible to prolong life far beyond the three score years and ten of the Psalmist. Whether this is desirable or not is an open question, for youth is not likely to view with equanimity the picture of seniors active and virile at the age, say, of one hundred and twenty. Values must, however, adjust themselves in this ever-changing world, and if men can retain all their faculties at one hundred and twenty years of age, they are not likely to consider the objections of youth in the matter

In Conant's book, although it bears the subtitle—"A Year's Course in Organic Chemistry" and is therefore written for those other than the men who intend to make organic chemistry a life-study, much of the higher biology is given in full detail. It is clear that the authors understand the great truth which all those who appreciate the science must recognize, namely, that it is only by the combination of organic chemistry and biology that progress can be made. Ultimately, the empiricism of biology will disappear and the new science of biochemistry will be based on organic structure and principles. When this happens, the clouds will pass away and in the brilliant light of the unfettered sun, discoveries will be made of far-reaching importance to the human race.

(3) This practical organic chemistry is doubtless a useful book for laboratories in which the course of laboratory work followed is in accordance with the text. For it happens that text-books of

this kind are usually written for the course chiefly to assist the teacher; it is rarely that the course is dependent on the text-book, although in some instances this may be the case The present book is probably written of the Cambridge laboratory course and shows incidentally that teaching in these laboratories is based on right principles. The book, no doubt, will serve for any of the organic courses in our universities and university colleges, but there it will have to compete with a host of similar books, some written for the requirements of a course, which are practically unassailable, having become firmly established by usage, others of general application which again have been established by long usage and are also practically unassailable from outside.

Nevertheless, the book under review is a good one and deserves fully all the success it can obtain. It is difficult to say, however, that it has any outstanding features which render it a book apart from its many competitors.

JOCELYN THORPE.

ENZYMES

Die Fermente und ihre Wirkungen
Von Prof Dr. Carl Oppenheimer Supplement. Band 1 (zu Band 1, Specieller Teil: Haupt-Teil 7–12.) Pp. xii+782 Band 2 (zu Band 2, Specieller Teil: Haupt-Teil 13–22). Pp. x+783–1738 (Den Haag. Dr. W Junk, 1936, 1939. 2 vols., £12 10s. Bibliography (1924–1938) Pp 1–128

FORTY years ago probably relatively few chemists or physiologists had any knowledge of enzymes, which were considered to be somewhat mystic bodies; the biochemist, if he existed, was regarded as a hybrid Emil Fischer had put aside the sugars for the time and commenced his work of taking the proteins to pieces.

To-day it requires a book of 1,738 pages in order to give concise information about the enzymes, and this is a supplement to an equally large volume, and consists mainly of new matter and not a repetition of the old. The preface to the supplement is dated August 1936 so that it has been three years in preparation, obviously three years of hard labour for the compiler

The constitution of the enzymes is largely unknown; they cannot be listed and formulated in the graphic chemical shorthand which has so facilitated the progress of chemistry and enables the expert to achieve so much with the vast majority of natural and synthetic substances This makes it doubly difficult to deal with the enzymes in books: they have to be classified by what they do, by the reactions for which they act as catalysts, rather than by what they are.

The difficulty has been largely overcome by Oppenheimer by an elaborate division into classes and frequent subdivision into entities resembling a zoological catalogue, and ultimately into numbered paragraphs. In consequence, with the aid of the schedule of contents it is as easy to look up a particular enzyme as it is to look up a compound of known structure in an organic chemical dictionary. The task has been accomplished and the book contains the latest up-to-date information about each and every enzyme, in the space of a few pages in paragraphs, subject only to the time lag of publication. It has been issued in parts, at irregular intervals during the three years, of which ample reviews have been given in these columns with the object of keeping workers on particular enzymes in touch with the progress of the supplement.

The extent of the interest in enzymes is evidenced by the amount of published work on them. The research has gone on side by side with that on vitamins and hormones, and some connexion or relation between these and the enzymes is beginning to appear. Their significance as catalysts of vital reactions has long been realized, but the stage has now been reached of understanding the mechanism of such reactions and the manner in which enzymes take part in them. Vitamins and hormones have become therapeutic agents, they are injected or taken by the mouth so that a deficiency in the body of such 'reaction-promoting' materials can be corrected This is scarcely true as yet of the enzymes though they are sometimes administered; more probably, the giving of hormones liberates enzymes which were previously dormant and brings them into action.

Apparently; vital reactions take place in a chain though, as this term has been appropriated by the physical chemists to connote another type of reaction, it is necessary to substitute the term 'series of substances'. Each compound in the series does something to or with another; the presence of each is necessary for the completed reaction. Some of the compounds are ordinary normal products of the cell, some are present only in minimal quantity, others are in the resting state as part of larger complexes and have to be unlocked, so to speak, before they react. A satisfactory book of reference contains the facts or indications of such, from which the worker can

build up further experiments and check his own theories.

From time to time there arise individuals, diligent and of orderly mind, gifted at cataloguing and summarizing the literature. Beilstein has done this for organic, Mellor for inorganic, Abderhalden for physiological chemistry, Oppenheimer for enzymology. The completion of this work entitles him to be ranked with these others as a benefactor to experimental science

All of them have made it easier for workers to-day to press forward their experimental investigations by which alone, slowly but surely, the truth is unveiled. E. F ARMSTRONG.

BIOLOGY FOR SCHOOLS

(1) A School Course of Biology
With Suggestions for Practical and Field Work By L J. F. Brimble Pp. x+470. (London . Macmillan and Co., Ltd , 1939.) 6s

(2) Biology for Junior Forms
With Instructions for Simple Practical Experiments. By M R Lambert. Pp 320. (London · Macmillan and Co., Ltd., 1939.) 3s.

(1) IN the preface to his book, Mr. Brimble writes that "the teaching of biology is still in the experimental stage, and thus the completely satisfying course which covers the period allocated to it in secondary schools is still to be formulated" It is inherent in the nature of progress that this completely satisfying course may never be attained, but it stands to the author's credit that here, as in his "Intermediate Botany", he has made a valuable contribution to biology teaching "A School Course of Biology" bravely attempts to deal with biology as a whole science in which no use is made of the "convenient" divisions into botany, zoology and physiology. The other general feature of importance is that the elements of human biology are liberally distributed throughout the text, and here lies the reason for much of the intrinsic value and attractiveness of the book

Although the requirements of candidates for school certificate and matriculation examinations are more than adequately provided for, whenever possible the author has carefully diverted the issue to deal with matters that make up the natural and ever-present interests of pupils Great prominence is given to economic uses of plants and animals, and attention is focused upon the human being in a section on human anatomy and physiology, with the attendant medicine, hygiene, health and fitness. Historical references are repeatedly inserted to illumine the facts presented. The pupil is invited to consider familiar plants and animals before attempting the unfamiliar. Another feature of considerable value is represented by the author's attempt to inculcate the spirit of inquiry by the frequent inclusion of suggestions to the effect that though much is known in science, the vast ocean of discovery lies largely uncharted.

Each chapter contains suggestions for practical work and, as an aid to examination candidates, some two hundred typical questions are provided. The 355 diagrams and photographs have been collected from many sources and are varied in appearance The great majority of the diagrams have been prepared by the author himself, these are uniformly excellent. It is to be desired that, when the book reaches its second edition, the author should even further extend its attractiveness by replacing the few poorer diagrams by yet more of his own There are a few inaccuracies which are of a trifling nature The only outstanding omission is that no reference is made to the pasteurization of milk, and the section dealing with soil might have been extended.

Mr Brimble's book should soon find its way to all schools where biology is taught and should be a real boon at present to teachers whose schools have been evacuated.

(2) "Biology for Junior Forms" is the adapted third book of a series that was written for senior schools This series was written using a concentric system so that each of them would cover a year's course. The third book has accordingly been published for use in the junior forms of Secondary Schools. It is doubtful, however, if it will achieve the same success in its present form as in the original. The pace of the introductory chapters appears to be too rapid for younger pupils, strange terms frequently being introduced without adequate explanation. The references to the earlier books of the series might also be disturbing to pupils having no previous acquaintance with them, while the exclusive divisions into botany, zoology and human physiology could scarcely be permitted in a book that is meant to be the foundation for Mr. Brimble's book on biology.

This little volume contains much useful material, however, and with a different presentation would perform valuable service in the lower forms of secondary schools. T. H. HAWKINS.

CIRCULATION OF THE BLOOD

The Control of the Circulation of the Blood
By Prof. R. J. S. McDowall, with the assistance of Lt.-Col. G. E Malcomson and I. McWhan. Pp. xv+619. (London, New York and Toronto: Longmans, Green and Co, Ltd, 1938.) 73*s*. 6*d*. net.

PROF. McDOWALL is to be congratulated on the production of a comprehensive 'Handbook' on the control of the circulation of the blood, with seven thousand references to other works It is surprising that he has found time to write it without interrupting either his teaching or his research work. His book covers the ground as completely as such books can, and does not follow the easy course of disposing of early work by reference to previous reviews, but contains much discussion of work published before 1900, where such work is still considered important.

A few minor errors are inevitable, and a warning to this effect is contained in the preface They can do little harm, since no serious man of science would rely on a monograph without referring to the original literature. The 38 figures are all taken from the author's own experiments, and their even distribution through the book reflects his close practical knowledge of all the problems discussed

There are 150 pages dealing with the control of the blood vessels in various parts of the body, 100 pages on the heart, 80 pages on adrenaline, and chapters on the effects of carbon dioxide, anoxæmia, temperature, sleep, exercise, posture, hæmorrhage, the pituitary, the hypothalamus, and vasodilator substances. The action of ions and the chemical transmission of nervous impulses are deliberately and wisely omitted; but it is a pity that there is no adequate account of the various theories that have been propounded to account for vascular shock. Perhaps the explanation is that the book has been confined to physiological phenomena, and shock is excluded as pathological

All physiologists who work on the circulation will covet this book, which will give them a long list of references, and a considered summary of many problems. It will save some of them from arduous searches in libraries and others from the publication of facts already known

J H. GADDUM.

STUDIES IN TELEPATHY

Experiments in Telepathy
By René Warcollier Edited and abridged by Gardner Murphy from "La Télépathie", articles in the *Revue Métapsychique*, and recent Unpublished Studies Translated by Josephine B Gridley. Pp. viii + 250. (London: George Allen and Unwin, Ltd., 1939.) 7*s* 6*d* net

THIS book is a collection of material taken from various publications by M. René Warcollier and put together with a foreword by Prof. Gardner Murphy of the Department of Psychology of Columbia University.

For some thirty years, M Warcollier has been studying the phenomena ascribed to telepathy, and in this volume he sums up his impressions of what he has learnt and gives numerous examples of successes in the reproduction of drawings, diagrams, etc., many of which are clearly not due to chance alone.

The main object of this collection of papers is not so much to offer fresh evidence for the existence of a telepathic faculty as to study and discuss the mental processes involved, and to try to ascertain how to produce the phenomena at will and thereby to initiate a detailed examination of the laws underlying them. Although the author was not successful in discovering any basic laws, his notes provide suggestive material for future experimenters Thus some of his results indicate that ideas repressed by the agent seem to be transmitted better than those upon which his attention has been concentrated; whilst the factor of the agent's own activity as compared with that of the percipient is seen in a number of experiments. On the other hand an increase in the number of agents seems to lessen their influence, whereas the opposite is true as regards the percipients, who, in certain cases, appear to be in mental rapport with one another.

Although much of M. Warcollier's work does not seem to be open to the kind of statistical treatment which is now being applied to problems of this kind, and through which we may hope to gain a greater insight into the questions involved, his work is of considerable interest, since he is particularly concerned with the kind of mental factors at work if the phenomenon is a real effect and not due to unascertained normal causes.

THE PUBLIC RELATIONS OF SCIENCE*

By Dr. Wesley C. Mitchell,
Professor of Economics, Columbia University

UNTIL recently the attitude of the public toward science seemed to be growing more appreciative. There have always been folk who objected strenuously to the supposed implications of certain scientific hypotheses, but on the whole science was generally esteemed the most progressive factor in culture, man's best hope for bettering his lot upon earth Of late this tide of approval has ebbed. There is a widespread disposition to hold science responsible for the ills men are bringing upon themselves—for technological employment, for the rise of autocracies, for the suppression of freedom, for the heightened horrors of war. For their part, scientific men are appalled at the hideous uses to which their discoveries are put They feel an urge to combat the misuses of science, to protect the social values they cherish, but what they can do is not clear. The quandary is one that all who cherish science should face, however unwelcome and difficult the task.

I

Let me start by recalling certain changes in the relations of science to society that may help us see our present problems in historical perspective.

The beginnings of scientific knowledge have been traced to man's dealings with the implements of his daily life—the sticks and stones, the skins, fibres, and clay he shaped to his uses, and in the shaping learned to know. At a later stage of cultural advance, thinking about natural phenomena, like thinking about religious observances, tended to break away from direct associations with daily work. Such efforts to understand the world as the Middle Ages made were concerned chiefly with problems of a divine dispensation Observation was not pertinent, and factual tests of conclusions were not possible.

The re-birth of science in the sixteenth and seventeenth centuries was accomplished by turning from the study of concepts back to the study of Nature. The new orientation was characterized by close observation, by the invention of devices to make observation more penetrating and accurate, by purposeful experimentation to simplify the processes observed, by close attention to quantity as well as to quality, by the practical application of mathematics to express the relations observed, by reformulation of concepts to fit the findings, by critical checking of one investigator's work by others, by the cumulation of tested conclusions in old fields of research, and by the extension of this mode of inquiry to new fields. Inventing instruments for observing, setting up experiments, measuring, and testing brought science again into intimate touch with the practical arts. Investigators took a keen interest in current affairs, sought to profit by the skill of craftsmen, and to put what they learned to practical uses. Discoveries were applied not only to the production of goods, but also to navigation, fortification, ballistics, and administration. By the close of the seventeenth century the dramatic achievements of 'natural philosophy' were leading many to expect an almost limitless advance, and the promotion of science was recognized as a proper object of public policy Kings lent their patronage to scientific societies Philanthropists followed the royal precedents by offering prizes for improvements in the arts and later by endowing research

Of course the public relations of science were not uniformly harmonious in this age of genius. But the celebrated clashes between scientific discoveries and beliefs held by churchmen did not affect many lines of inquiry and did not gravely retard the rising tide of investigation Not less characteristic of the age than Galileo's troubles were Newton's services to churchly teachings and to the State Scientific men have lamented that he devoted his later years to arguing the validity of biblical prophecies ; they have paid less attention to his work as Warden of the Mint. It was adjustments in the weights of the guinea and the shilling suggested by Newton that gave England a *de facto* gold standard in the eighteenth century.

An even more striking example of close relations between research and service to mankind is the life of Benjamin Franklin. The foremost American discoverer of his time, he was foremost also in applying and disseminating science to make life more comfortable, more secure, more interesting, more humane. These activities were incidents in the life of a busy printer, editor, politician, postmaster, legislator, colonial agent, and diplomat. But while we wonder at the extraordinary versatility of a man who could become both a scientific discoverer and a great statesman under any conditions, we must remember that in Franklin's day science was still in its 'natural philosophy' stage.

* From the address of the retiring president of the American Association for the Advancement of Science, delivered on December 27 at Columbus, Ohio.

With the cumulation of results, science became a more exacting mistress, requiring of her votaries more exclusive attention. But science did not draw away from the material tasks of daily life as it had in Greece. On the contrary, these relations were becoming more intimate, while scientists were learning to speak symbolic dialects less and less intelligible to the public or even to one another. Let me illustrate the seeming paradox by the relations between science and industry

To most of us the modern age is characterized by technological progress as markedly as by scientific discovery. We think of the two achievements as interdependent This interdependence was less obvious to Franklin's contemporaries than to us. Theirs was a century of great inventions, but inventions made mostly by men not trained in science. The captains of industry who carried the Industrial Revolution through its youthful phases were often technical experts, business executives, and capitalists united in one person. Men of this versatile type are still to be found even in 'big business'; but they are becoming as rare as once they were common. For, as technology was elaborated, experts with special training were required to supervise its operations.

The economic results produced by this unplanned organization of mutually stimulating activities astonished mankind Industry after industry reorganized its processes time and again to take advantage of the latest engineering applications of scientific discoveries, and new industries kept cropping up The efficiency of human labour increased greatly, *per capita* income rose, and hours of labour declined. Higher standards of living, and applications of science to the prevention and cure of disease, reduced death-rates and prolonged the average duration of life. Population grew rapidly in the nations that led the scientific procession, and spread where it would over the earth, dominating, exploiting, sometimes exterminating the non-scientific peoples Life became ampler if not easier for the beneficiaries of science.

What industry owed science it repaid in many ways. It provided in bewildering variety laboratory equipment more accurate and powerful than that made by hand It stood ready to construct any new contrivance an investigator designed, and often improved upon the original plans Fortunes accumulated in business were the source of many scientific endowments Business corporations granted research funds to universities, and set up research staffs of their own, which were sometimes permitted to work upon fundamental problems.

Governments recognized the social importance of science by making place for an expanding array of scientific courses in public schools and universities, and by undertaking wide-ranging programmes of research. In the United States, the Federal Government became the largest employer of scientific men. At the time of the Civil War it chartered the Academy of Sciences, and in the War of 1914–18, the National Research Council to advise it upon scientific problems; in 1934, it set up the organization that has developed into the National Resources Planning Board, with affiliations covering the full gamut of the sciences.

Finally, the public at large had a share in these great changes. It was the ultimate beneficiary of reductions in costs of production, of increasing *per capita* output, of new types of consumers' goods, of shorter working hours, of better protection against disease, of free education

In short, this policy of *laisser-faire* worked wonders. Science helped industry and industry helped science. Even the backward art of agriculture, which faces so many difficulties and uncertainties, was benefiting by research The dreaded 'law of diminishing returns' seemed to be overbalanced by improvements in practice based upon the work of soil chemists, botanists and geneticists The frightful prospect of over-population that Malthus had taught the thoughtful to fear seemed to be dissipated by scientific agriculture and scientific techniques of contraception. Best of all, science seemed to have found the secret of illimitable progress.

II

I doubt that any scientist ever accepted without qualification this idyllic version of the benefits science confers upon mankind. Certainly there were numerous protests from scientific quarters against misuses of the new technology. Geologists and economists warned against the rapid depletion of mineral deposits. Chemists feared for the nitrogen content of the soil. Geographers and meteorologists protested that wholesale cutting of forests and the ploughing of grass lands produced deserts. Biologists lamented the extinction of animal species and anthropologists the callous stamping out of simpler cultures. Social scientists found much amiss within the countries that were most progressive. Urban and rural slums persisted as centres of disease and crime. The need of securing capital to utilize the new technology put control over it into the hands of the propertied classes. Labour was often grievously exploited. Huge fixed investments that could be used for only one purpose made competition destructive. The obvious escape from these hazards was to form monopolistic combinations. That was pleasant for the monopolists, but not for other business men or for consumers. Besides the obvious dangers of

exploitation, many feared that the great combinations might purposely slow down technological advance because it threatened rapid obsolescence of their equipment.

Business did not manage even its own interests properly, for every few years it generated a crisis and depression in which it suffered along with the whole community, and the international relations of the scientifically advanced peoples showed at his worst "the old savage in the new civilization". Demonstrations of the economic advantages of free trade no more stopped the imposition of protective tariffs than demonstrations of the horrors of war kept peace. Militant nationalism seemed to be spreading and growing more passionate. An appreciable fraction of scientific energy was devoted to contriving weapons of destruction. Thus against the glowing pictures of science as a benefactor of mankind could be set a dark picture of science putting more power into the hands of certain individuals, classes, nations, generations, giving them a differential advantage over others which they exploited according to their several natures.

Though some of the Jeremiads I have been recalling belong to an earlier time, they did not produce a profound effect upon the public relations of science until recently. The ills complained of could be regarded as 'growing pains'. They represented social 'problems', which should be dealt with by arousing public opinion in a campaign of education that would lead to remedial legislation. Problems that could not be solved by this time-honoured method would yield presumably to the slower processes of general enlightenment.

This optimistic attitude was particularly characteristic of democratic nations. It assumed tacitly that experts could devise whatever 'reforms' were needed, and that the majority of voters were intelligent enough to understand, and well disposed enough to support, desirable changes. Science had a stellar role in this programme for remedying the ills incidental to progress. It did not claim knowledge of good and evil, but it enabled men to make their value-judgments more intelligent by tracing the consequences of actions. Many people were devoting their energies to the study of social problems; they spoke optimistically of their subjects as social 'sciences'. It seemed not too much to hope that science might presently begin to guide social practice in somewhat the same fashion as it guided practice in industry and medicine.

III

That the public relations of science have recently become disturbing both to the public and to scientists is due, not to any change in the character of science or the behaviour of scientists, but to changes in social conditions. While most people approved on the whole of the applications of science before 1914, they have come to dislike many of the effects produced by later applications. To be specific: when scientific improvements in one industry after another threw men out of work in earlier decades, the victims might suffer in silence or protest riotously and perhaps smash machines. But the public at large was not deeply concerned over their sufferings; it repressed disorder, expected the displaced men to find new jobs for themselves, and blessed science for reducing costs of production. Now that a larger part of the public suffers from loss of work or obsolescence of investments, science is blamed for technological unemployment. When the modern arts of communication were used to facilitate the political processes of democratic nations, they were extolled on all sides. Now that these arts, further improved, are controlled in some countries by autocratic Governments and used to suppress opposition, many good people treat science as the culprit. When the scientific nations used their superior arms against backward peoples, only a few sensitive souls were wrathful over the unfairness or iniquity of the procedure. Most people felt that science was good when it gave them a decisive advantage over those they wished to 'civilize'. Now that these same nations are threatened by still more terrible weapons in the hands of their peers, their moral horror is sincere, and they wish scientific warfare back to the pit from which it was digged.

This shift in attitude toward science as one happens to benefit or suffer from its applications is doubtless a mark of human frailty, but it is one at which scientists should not cavil without recalling a similar frailty of their own. Now that we are on the defensive, we discover that science is neither good nor bad in itself, but is merely an instrument that can be put to good or bad uses, and that the blame for bad uses should be visited upon those responsible for them. But when science was being lauded for good works, who among us argued that the credit belonged, not to science, but to those who used it for the benefit of mankind?

We made this discovery when difficulties forced us to think more carefully about the place of science in society. Well as the old policy of *laissez-faire* in public relations worked for a time, it had encouraged in us an indolent complacency foreign to the critical spirit of inquiry. We may not enjoy the shocks that have aroused us any more than an investigator rejoices over facts that disprove an elegant hypothesis; but we must face the situation and see what we can do to mend it. I venture to suggest an obvious proposition that seems to me of controlling importance, and to

point out certain corollaries that should guide both our attempts to understand the public relations of science and our future policy concerning them.

IV

The fundamental proposition is that scientific research is a social process as much as business, political, or religious activities are, and as such is interwoven with all other social processes, influencing them and being influenced by them It is one among many social activities carried on by the peoples of our culture. Like all such processes, it is carried on by men who learn in childhood languages ill-suited to close thinking, by men who wish to eat, to make love, to win approval as well as to know; by men who are reared in an environment of emotional likes and dislikes; by men who become so absorbed in their technical tasks that they have little energy to criticize the non-scientific parts of their own make-up These scientific men form a tiny fraction of their communities. So far as they succeed in emancipating themselves from the misconceptions and prejudices prevailing in their social groups, they become by virtue of their partial emancipation queer creatures whose judgment most people mistrust outside of their specialties. Both the temperament that inclined them to research and the habits they form in research tend to make them awkward, ineffective, reluctant in appealing to the emotions that are so potent in influencing men.

It is difficult to see how a few scattered individuals, each accustomed to think for himself and to be critical even of his fellow inquirers, can guide public opinion except by slow educational processes In the long run, their thinking may rule the world, just because it serves the purposes of mankind better than the traditional thinking it gradually replaces. But in the short run, others take of scientific discoveries only the parts that have an immediate application, and put these parts to such uses as they see fit—uses that serve whatever aims these others pursue The prompt and potent influence of science upon society comes from these uses, good and bad, which scientists control only in small part

Even in democratic countries, then, scientific men find it hard to bridge the gulf between their attitudes and those of the general public. In autocratic States the Governments might give scientists fuller opportunities to direct public policies than they enjoy in the democracies But the autocratic States known to us are not built on that model. They are avid for science, to be sure, but only for science that is an uncritical servitor of ends the rulers determine. As between the difficult public relations confronting them in democracies and the shackling of free inquiry confronting them in autocracies, scientists cannot hesitate. Theirs is a world of intellectual freedom, not perfect alas, but the freest world the mind of man has yet created, and to let any authority under any pretence prescribe what conclusions they shall accept as scientific is to stultify the spirit of science.

V

What, then, can scientists do to improve their public relations in communities where they are relatively free?

As I see the situation, they have two sets of opportunities and responsibilities; first, their opportunities and responsibilities as citizens; second, their opportunities and responsibilities as investigators.

What scientific men can do as citizens is like what other intelligent men can do. If democracy is to work well, many people must form considered judgments upon a wide variety of problems. In forming a considered judgment on a given issue, what experts have to say should be taken into account. Who these experts are depends upon the character of the issue; more often than not contributions are needed from several kinds of specialists. All the many species of the genus scientist belong at one time or another in the list of desirable technical advisers, so also do lawyers, business organizers, labour leaders, social workers, educators, civil servants, politicians, and so on. When matters within the competence of some group of scientists are involved, they should contribute what they know, whether formally invited to do so or not. To make their advice effective they should welcome help from people more skilled than themselves in the arts of popular presentation. On matters concerning which a scientist has no special knowledge, he should listen to others and form the best judgment he can from what they advise To an individual this task of sifting and weighing different opinions is time-consuming and difficult. On complicated issues organization is needed to bring into focus all the intelligence available in the community. Hence one of the civic duties incumbent upon all scientific men in common with other citizens is to support vigorously but critically the nascent movement toward organizing all the intelligence we possess for constructive study of social problems, before they become pressing emergencies that have to be dealt with in a hurry that allows no time for careful thinking.

The outside limits of what scientists can accomplish as citizens are set by their ignorance. Not merely does no individual have more than a tiny

fraction of the knowledge that is needed; all the scientists of the country put together do not know enough to solve many of the problems that a democracy faces. In addition to the responsibilities they share with all other citizens, scientific men have the special duty of trying to increase the kind of knowledge required to deal intelligently with public problems. Their opportunities and responsibilities as citizens merge into their opportunities and responsibilities as investigators

From the social point of view, the most urgent item in the unfinished business of science is to increase knowledge of human behaviour. If we had keener insight into individual psychology, we might not be able to alter fundamental drives, but we might be able to direct them into beneficent channels. Preaching righteousness doubtless prevents men from being as bestial as they might otherwise become Appeals to reason prevent them from making as many errors as they otherwise might. But the moralist and the rationalist admit that the results of their efforts are grievously disappointing. Scientific men with any gift of self-analysis realize that they have their own shares of selfishness and animosities To subdue traits in oneself is hard enough to give an inkling of the difficulty of controlling them in society at large. Perhaps—and perhaps is all we can say—if we can come to a clearer understanding of how we behave, we can learn how to condition men so that their energies will go less into making one another miserable.

We all know that the social sciences lag far behind the natural sciences. That is because they deal with phenomena more complicated, more variable, and less susceptible of experimental manipulation. Since social investigators cannot experiment at will upon social groups, they cannot effectively apply to their problems the methods that have made the laboratory sciences strong.

Yet the case of economics and its sister sciences is not hopeless. The rapid growth of statistics is providing mass observations upon social behaviour of many kinds; the equally rapid growth of statistical technique enables us to learn more from a given array of data than our predecessors could. These materials and methods are making it possible to measure many social factors, some rather accurately, some roughly. Uniformities appear not only in averages, but also in the way in which individual items are distributed about their means. Statements in terms of probability can be substituted for vague statements about the effect a certain cause 'tends' to produce. True, work on this observational basis encounters many difficulties. It is limited by the variety, extent and accuracy of reliable data upon human behaviour. It is laborious, slow and expensive. In presenting his work a realistic investigator begins with a critique of his data and methods; he ends by setting forth the probable errors and limitations of his results, and the road from the beginning to the end may be long. Instead of definitive conclusions he thinks others should accept, he presents tentative approximations he expects others to improve. The work has not even the advantage of calling for less hard thinking than speculative theorizing; for the relations among the variables in the problem are seldom manifest of themselves. All that can be claimed for this type of work is that it deals with actual experience, that its results stand or fall by the test of conformity to fact, and that it grows cumulatively after the fashion of the observational sciences. But that is enough to give mankind strong reason for following this lead in seeking the knowledge required to improve social organization.

But science cannot flourish in the future and yield the fruits for which we hope unless freedom of thought prevails. The democratic way of life and the scientific way of thinking grew up together, each nourishing the other. If one now fails, the other will falter. Where democracy is suppressed to-day science is fettered; for autocracy cannot brook disinterested criticism of its dogmas or its practices. Freedom of scientific work in the years to come can be guaranteed only by preserving the institutions that secure freedom to all citizens.

Perhaps scientific men have more at stake than any other social group in the struggle to maintain democracy. To this struggle they can make a crucial contribution. The fact of free societies hangs upon the wisdom or folly of mass decisions. The gravest dangers to democracy come from within, not from without They are ignorance, and propaganda that turns ignorance to its uses. The best way of dispelling ignorance is by diffusing knowledge. The most effective defence against meretricious propaganda is critical inquiry. John Dewey is warranted in saying that "the future of democracy is allied with spread of the scientific attitude". To foster this attitude among their fellow citizens by all means within their power is a duty incumbent upon us who cherish science As teachers in schools and colleges we can help thousands to develop respect for evidence. As citizens we can be brave opponents of prejudice and hysteria. We can promote general understanding of the methods and results of science through our own writings or those of allies more skilled in popular exposition. These things we should do, not as high priests assured that they are always right, but as workers who have learned a method of treating problems that wins cumulative successes, and who would like to share that method with others.

A NEW APPLICATION OF ECHO-SOUNDING

BY DR. C. H. MORTIMER AND DR. E. B. WORTHINGTON,

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE

BY 1937 the biological researches at Wray Castle had reached the stage when a detailed bathymetric survey of Windermere was desirable as a basis for studying features of the lake bed. The Hydrographer to the Admiralty kindly agreed to co-operate on the technical side, and a survey was carried out by Lieut.-Commander Farquharson, of the Admiralty's hydrographic staff, using a magneto-striction recording echo-sounding machine of Admiralty pattern manufactured by Messrs Henry Hughes and Son, Ltd. The main feature of the recorder (Fig. 1) is a drum which is rotated at a constant speed by an electric motor. An arm attached to the drum carries a metal 'pen' which traces the record on paper moistened with solution of potassium iodide and propelled slowly through the machine. Contacts on the drum are arranged in such a manner that a supersonic sound impulse is transmitted from an oscillator, below the surface of the water, for an instant when the revolving pen has just begun its transit across the paper. The sound impulse, directed downward, is reflected from the bottom, is picked up by a receiving oscillator also mounted in the water, is amplified and passed to the pen. The rises in voltage at the pen point, consequent on the transmission and return of the signal, cause electrolysis of the potassium iodide and produce brown stains of iodine on the paper—one, the zero mark, at the instant of transmission, and the second on the reception of the echo. The distance along the arc of the pen's track between these two marks represents the depth of water, and the process, repeated at each revolution of the drum, gives a continuous record of depth. The whole equipment, consisting of the recorder, amplifier, oscillators and 12-volt accumulator, can be mounted comfortably in a small launch or rowing boat.

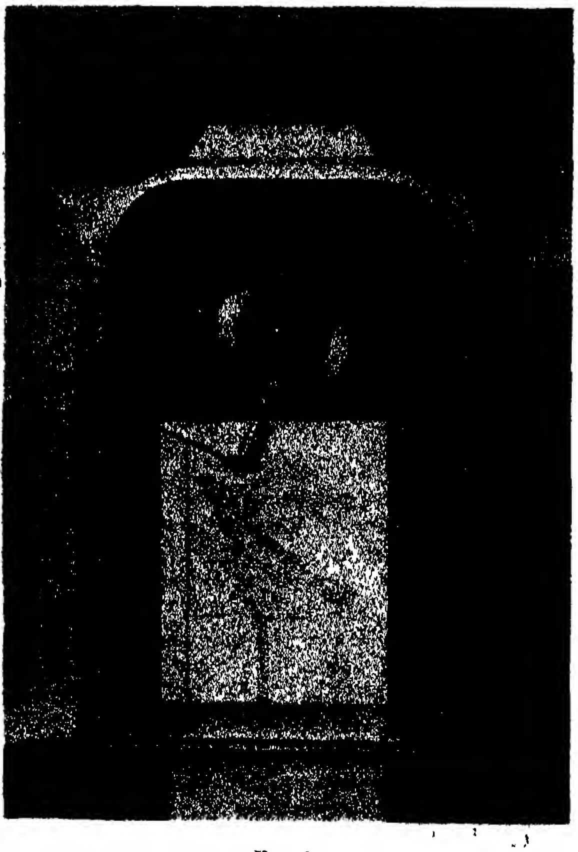


Fig. 1

THE HENRY HUGHES ADMIRALTY PATTERN ECHO-SOUNDING RECORDER

In the survey of Windermere 260 cross-sections, representing some 150 miles of continuous sounding, were recorded during five weeks, and the measurements of depth were afterwards made available by the Admiralty on the 6 in. to a mile scale, with certain areas in greater detail on 25 in. to a mile maps. The results of this survey, sufficiently valuable in the information they provided regarding the depth of water, proved to be of much interest in quite another way. Many of the records not only showed an echo from the floor of the lake, but also a second, though fainter, echo, and sometimes more, at vertical distances (measured on the records) of up to 13 metres below the lake floor. It is known that much of the lake bottom is covered by soft mud of considerable depth, presumably overlying rock or glacial clays which formed the floor of the lake at the conclusion of the Ice Age. Therefore, it seemed that the double echo shown on the records

could be explained on the assumption that only some of the sound waves transmitted by the machine were reflected from the interface between mud and water, and that others penetrated the waterlogged deposits and were reflected by the harder glacial clay or solid rock underneath In other parts of the lake (*A* in Fig 2) the bottom appeared as an intense black mark with one or more fainter marks below, at apparent distances below the bottom equal to the depth of water In such cases it seemed justifiable to assume that all the sound waves were reflected from a hard bottom and that, since an air-water interface reflects supersonic sound, they were afterwards re-echoed to and fro between the surface and bottom. If these interpretations were correct, the echo-sounding machine could be used to give information regarding the kind of bottom and the depth of soft deposits Accordingly, the research was followed up by (1) making observations on the deposits themselves, and (2) carrying out surveys with the echo-sounder on fourteen other of the larger lakes in the district.

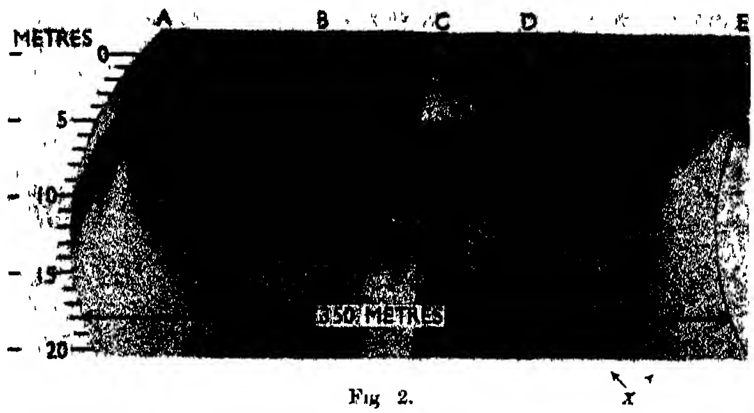


Fig 2.
Echo-record of a section across Low Wray Bay, Windermere
X are time marks recorded every thirty seconds.

In the first of these projects, sections such as that shown in Fig. 2 were examined and it was confirmed by the use of lead and grab that at *A* the bottom is bare rock, at *B* it is soft mud, at *C* stiff clay overlain by a thin deposit of soft mud. At *D* beds of water weed (Potamogeton) growing in the mud were under the oscillators as the superficial marks made their appearance on the record, and at *E* a stony bottom could be seen through the shallow water. Direct measurements of the actual depth of soft deposit were made with a probe of special design constructed by Dr. J. A. Ramsey of Cambridge. Of twenty-one such measurements made under favourable conditions, all showed depths which agreed to within a foot with the depth of deposit as indicated on the echo records. In addition, cores of the deposits have been obtained from some parts of the lake, first with a simple tube driven into the bottom and later with a special core-sampler described previously[1]. The examination of cores is important because many of the echo-records (for example, at some points in Fig. 2) indicate stratification of the deposits Moreover, the cores throw light on the post-glacial history of the lake basin. they show fine varving in the deposits, and there is an alternation between periods in which inorganic, probably ice-eroded, particles are predominant with periods when the bulk of the deposit is made of the shells of diatoms. The succession of diatom and other organic remains in these cores is being studied by Miss W. Pennington of the University of Reading.

The surveys of other lakes, made by members of the staff at Wray Castle, serve to confirm the main bathymetric features as determined by H. R. Mill[2].

Fig. 3.
Echo-record of section across Esthwaite Water.

These surveys were not of the same detail as that of Windermere, but sufficient sections were recorded to obtain a good idea of the bottom characters. The photograph of a representative record from Esthwaite Water, reproduced in Fig. 3, shows a mound of hard bottom projecting through an even layer of soft deposit. Over the rest of the section the thickness of soft deposit is roughly uniform and the mud profile follows in smoother outline the irregularities of the hard floor below. In other cases, for example at *D* in Fig. 2, such irregularities are masked by a level blanket of mud. Fig. 4 shows another type of sedimentation in a region—the narrows joining the north and south basins of Windermere—in which an appreciable water flow is to be expected. The figure shows a scoured channel on one side with a mud bank on the other, a condition which might be expected from the configuration of the locality. A more complex kind of sedimentation, in which the deposit appears to be divided into a series of strata, is suggested by other records. All these types of record have been exactly reproduced over the same positions at different times by two recorders having differences in the details of construction, and recording on different scales.

It must be emphasized that further direct observations on the deposits are required before the interpretation of the echo-records can be accepted without reserve. The speed of travel and the penetration of supersonic sound in water-logged deposits have yet to be determined, and the nature of the interfaces from which it is reflected awaits investigation. But it seems probable from the results mentioned above that the echo-sounding machine provides a means of measuring the result of subaqueous deposition over long periods of time. Such measurements would be of practical use in connexion with reservoirs and harbours where the deposition of soft deposit on a hard floor often takes place rapidly. They would also be of much interest to hydrographers, geologists and limnologists. For example, in each lake so far examined, the total volume of soft deposit, as computed from the echo-records, is found to be related to the size and character of the drainage basin. This is illustrated in the accompanying table of values for selected lakes.

	Mean depth of water (metres)	Mean depth of deposit (metres)	Volume of deposit (10^6 cubic metres)	Drainage area (sq. km.)	Volume of deposit / Drainage area	% drainage area on uncultivated hills
Haweswater	12·0	0·52	0·7	29·1	2·4	92
Ennerdale Water	18·9	0·88	2·5	44·1	5·7	94
Coniston Water	24·1	1·09	5·4	60·7	8·9	78
Windermere	23·8	1·62	24·1	230·5	10·5	70

The figures in the last column but one represent the depth of deposit in centimetres if it were spread evenly over the whole drainage basin, and may be regarded as an index of silting rate. Pearsall[3] showed the controlling influences of the silting rate on the distribution of aquatic plants; his classification of the lakes of the district on this basis is corroborated by the new data from echo-sounding.

Since the work described above was carried out, the work of Stocks[4] and Rust[5] has been brought to our notice. Using a different type of non-recording echo-sounder in Kiel Bay, they obtained double and multiple echoes over soft bottoms in contrast to single echoes over hard bottoms, and they put forward an interpretation similar to the one advanced here.

We are much indebted to Messrs. Henry Hughes and Son for the loan of echo-sounding machines and to those scientists who have given help in the work. A fuller account of the surveys is being published elsewhere[6].

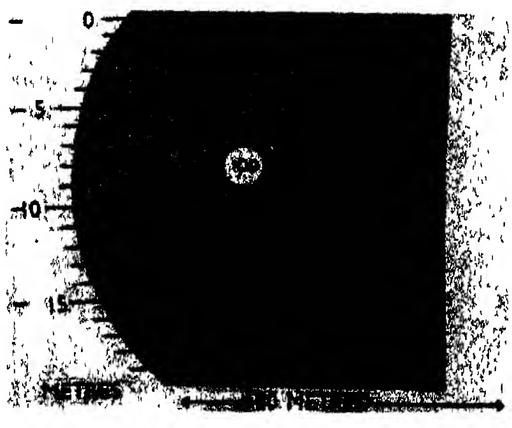


Fig. 4.

ECHO-RECORD OF SECTION NEAR THE FERRY, WINDERMERE.

[1] Jenkin, B. M., and Mortimer, C. H., NATURE, 143, 834 (1939).
[2] Mill, H. R., *Geog. J.*, 6, 46–73, 135–166 (1895).
[3] Pearsall, W. H., *Proc. Roy. Soc.*, B, 92, 259–84 (1921).
[4] Stocks, T., *Naturwiss.*, 23, 283–87 (1935).
[5] Rust, H., *Naturwiss.*, 23, 337–39 (1935).
[6] Mortimer, C. H., *Geog. J.*, in the press.

OBITUARIES

Prof. F. K. Richtmyer

THE death of Prof. Floyd K. Richtmyer on November 7 has removed a notable figure from scientific circles in the United States. Born in 1881, he graduated at Cornell, most of his academic life being spent as a member of the staff of this same University His doctoral dissertation was on the subject of photoelectric phenomena, and studies on physical photometry occupied several years of research, during which time he worked under the guidance of E. L. Nichols.

During the War of 1914-18 the urgent need of optical information and instruction in connexion with the development of military instruments and with numerous problems of vision not only led to the rapid growth of the Optical Society in London but also to the foundation of a strong sister society in America. Dr. Richtmyer, appointed in 1918 to a full professorship at Cornell, was a leading figure in the American Society from the beginning, and played a most important part in the subsequent development of the American Institute of Physics.

At various times he was elected to the presidency of the Optical Society of America, the American Physical Society, and the American Association of Physics Teachers. He was associate editor of the *Journal of the Optical Society* from 1917 onwards, and in 1932 he became editor-in-chief of the *Journal* and the *Review of Scientific Instruments*. In the same year, he was elected to the National Academy of Sciences.

Anyone who knows the characteristically friendly meetings of the Optical Society of America, held fairly frequently at various centres in the States, will fully appreciate the careful organization that must have been carried out by a group of which Richtmyer was one of the leading figures His careful and thorough work as editor of the *Journal* has benefited many who appreciate the high standard which is maintained in its pages. Perhaps he is best known to present-day students of physics through his text-book "Introduction to Modern Physics", in which his great gifts as a teacher and expositor are reflected.

In recent years Richtmyer had many administrative duties at Cornell, that most pleasant of universities with its tree-shaded campus high above the blue waters of the Senaca Lake, but he found time to direct the studies of a class of graduate students in a laboratory where the atmosphere is progressive and stimulating. His chief recent interests lay in the fields of X-rays and spectroscopy, and many papers have borne witness to his thoroughness and care in experimental work.

The many in the United States who relied on Richtmyer's judgment and experience will miss him greatly and their regret will be shared by many in Great Britain who had the privilege of meeting him.

L. C. MARTIN.

Mr. G. Herbert Nall

THE death of Mr. G. Herbert Nall at the age of seventy-nine years occurred on January 14. Mr. Nall was educated at Shrewsbury and at Queen's College, Oxford, where he took a second class in Classical Moderations (1881) and in Lit. Hum. (1884). He was appointed lecturer in Queen's College in 1884 and was classical master and librarian at Westminster during 1886-1922. He was housemaster of the Home Boarders from 1895 and edited many books of the classics for use in schools.

As well as being a classical scholar, Mr. Nall had a bent for natural history which was developed by angling in Great Britain and the Scandinavian countries while he was at Westminster. After he retired he took up the scientific investigation of the life of freshwater fish and in particular of sea trout and trout. Working under the auspices of the Fishery Board for Scotland (now the Fisheries Division of the Scottish Home Department) he applied the technique of scale reading to, and became the recognized authority on, this species. As his work developed, it became clear that the life-story of the sea trout was more complicated and liable to greater variations than that of the salmon, and if a true picture was to be obtained an extended and detailed investigation would be necessary. This laborious task Mr. Nall attacked wholeheartedly. In spite of the size of the undertaking he was never daunted by detail and never thought any trouble too great in order to be sure of his material or of the facts which he elicited from it. His main work was in Scotland, but in addition he did much in England and Wales: he also did not omit Ireland and certain European countries from the scope of his survey. He finished his fortieth paper (publication of which will unfortunately be delayed by the War) for the Scottish fishery department a few minutes before he died. Many other papers by him were published in various journals. His latest work did nothing to disturb his conclusions reached a few years ago, and his "Life of the Sea Trout" will for long remain the standard work on that subject. It is not too much to say that our very complete knowledge of the life-history of the sea trout is due almost entirely to his efforts.

In the death of Mr. Nall, freshwater fishery research in Great Britain, and particularly in Scotland, has lost an enthusiastic and painstaking worker who has accomplished much. In his passing those who knew him have lost a quiet, humble soul and one who never failed to help others.

We regret to announce the death of Sir Gilbert Morgan, O.B.E., F.R.S., formerly director of chemical research, Department of Scientific and Industrial Research, on February 1.

NEWS AND VIEWS

Two Eminent Swedish Chemists

THE year 1840 saw the birth of the two Swedish chemists, Per Theodor Cleve and Lars Fredrik Nilson, the former of whom was born at Stockholm on February 10. Cleve was the son of a merchant, Nilson the son of a farmer of Ostergothland Both of them became students at the University of Uppsala, where they came under the influence of L. F Svanberg, who had been the friend of Berzelius. After graduating, and teaching chemistry at Uppsala, Cleve worked in Wurtz's laboratory in Paris, and in the mineralogical laboratory at Stockholm; he then made a geological excursion to the West Indies After his return home, in 1870 he was given a post at the Stockholm Technical Institute, but on Svanberg's retirement became professor of chemistry at Uppsala and held this position until shortly before his death. Like his contemporary Nilson, he did valuable work on the rare earths, and he showed that scandium, the element discovered by Nilson, was identical with the eka-boron of Mendeléeff. It was partly for his work on the rare earths that he was in 1894 awarded the Davy Medal of the Royal Society. Towards the end of his life he became absorbed in biological studies. For the Chemical Society, of which he was a foreign member, he wrote the memorial lecture on the Swiss chemist J. C G. de Marignac (1817–94) He died at Uppsala on June 18, 1905.

While Nilson was also known for his investigations on the rare earths, he rendered great service to his country as an agricultural chemist. Farming was in his veins, and he always retained an interest in the prosperity of his native district. After holding the chair of analytical chemistry at Uppsala from 1878 until 1883, he was called to Stockholm as professor of chemistry in the Royal Academy of Agriculture. In the next sixteen years, while engaged on his official duties, he published nearly sixty papers on soils, manures, etc, and his inquiries led to the draining and cultivation of the swamps of Gothland, and to the introduction of the sugar beet. He was elected a foreign member of the Chemical Society in 1888. He died on May 14, 1899, in his fifty-ninth year.

The Parliamentary and Scientific Committee

A MEETING of the Parliamentary and Scientific Committee was held at the House of Commons on January 31. In the absence of the chairman, Captain D F. Plugge, M P., the chair was taken by Major H A. Procter, M.P. The Secretary announced that the following bodies have now definitely agreed to support the new Committee: Association of Scientific Workers, Institute of Chemistry, British Association of Chemists, National Veterinary Medical Association, Institution of Structural Engineers, Institution of Marine Engineers, British Association for the Advancement of Science, Institution of Mechanical Engineers, Pharmaceutical Society of Great Britain, Institute of Fuel, Institute of Gas Engineers, Thames Barrage Association, Oil and Colour Chemists Association, Institution of the Rubber Industry, Association of Applied Biologists, Universities Federation for Animal Welfare.

The Secretary also reported that the following Members of Parliament had agreed to become members of the Committee: Captain Plugge, Colonel Baldwin-Webb, Mr Markham, Mr E W. Salt, Mr. Alan Chorlton, Dr Haden-Guest, Sir John Graham Kerr, Mr. R. R. Stokes, Sir Murray Sueter, Mr. David Adams, Mr. Henry Haslam, Sir Ernest Graham-Little, Major Procter, Mr Kenneth Pickthorn, Mr. W. Higgs, Mr. R. H Morgan, Mr. W. R. Duckworth, and Mr. I. C. Hannah It was agreed to give all possible support to affiliated scientific and technical bodies in ensuring fair treatment for scientific and technical workers in connexion with military service, not only so far as the list of reserved occupations is concerned, but also with the view of ensuring that the special qualifications of scientific and technical workers enrolled in the Fighting Services should be properly appreciated and developed. Discussion also took place on the report of the sub-committee which has been investigating the question of the nutritive value of bread, having regard to the importance of bread as an article of diet in war-time.

Venereal Diseases in War-time

AT an extraordinary general meeting of the British Social Hygiene Council, held on January 29, attention was concentrated upon the circular letter recently dispatched by the Ministry of Health to local government authorities relating to the control of venereal disease in war-time. During the War of 1914–18, some 400,000 members of the armed forces were treated for venereal disease, necessitating the withdrawal of the majority of the patients from active service for periods varying between five and six weeks. To-day, the Ministry is anxious that the great reduction in the numbers of people suffering from venereal disease since 1918 should be at least maintained during the social upheavals that are caused by war conditions. The movements of population from towns to the vicinity of munition factories, military camps and aerodromes in the country districts bring grave problems

In the circular the Ministry of Health emphasizes the need for the maintenance of existing measures for the treatment of the diseases, while, in areas where the services provided are deficient, it is suggested that clinics and personnel should be adequately augmented. The introduction of fully

equipped mobile clinical units is suggested for increased efficiency. It was pointed out at the meeting that no financial assistance is provided, and the burdens now borne by local authorities are such that without assistance from the national exchequer little can be done. Further, it is felt that the Ministry's circular pays insufficient attention to the enlightenment of the public as a preventive measure and makes no mention of the needed increase in the number of trained venereal disease almoners. The omission of any reference as to the means whereby local authorities are to be financially re-imbursed for providing these services has caused considerable dissatisfaction. A strongly worded resolution to that effect was adopted.

Development of International Health Organizations

IN a recent paper (*Ann. Med. Hist.*, 3 ser., 1, 519; 1939), Dr. Robert A. Lyon, of Cincinnati, points out that before the nineteenth century individual nations or cities tried to check the entrance of disease by the application of quarantine laws at ports and land frontiers. It was not, however, until the early decades of the nineteenth century that international co-operation in health matters was first sought by countries on the Mediterranean. In 1839, Turkey invited representatives of other nations to meet a Sanitary Commission at Constantinople for better co-operation in the enforcement of quarantine regulations. A few years later, Egypt made a similar request, and in 1869 the Egyptian Council at Alexandria undertook the medical supervision of traffic through the Suez Canal. In 1851 the first International Health Convention met in Paris, and since then thirteen similar conventions have been held in different European cities and at Washington for the purpose of formulating regulations concerning the notification of cholera and plague and arrangement of medical inspection of crews and passengers as well as the inspection and disinfection of cargoes.

In 1909 there was established in Paris an International Hygiene Office, the function of which has been to collect and unify the many national laws of sanitation and quarantine, to supervise the health laws applicable to pilgrims, to establish medical facilities for the treatment of venereal disease in ports in all parts of the world, to investigate the transmission of disease by aerial navigation, to publish public health information, and to carry out specific investigations. The organization of a Health Section of the League of Nations began in 1920, and in 1921 it became part of the permanent secretariat of the League, with offices in Geneva. The Section consists of three divisions, namely, a directing committee, a consulting committee of experts consisting of the directors of the International Health Office, and an executive staff composed of public health experts, statisticians and clerks who devote their whole time to the work. The Section has done valuable work in the control of epidemics, the standardization of medical procedures, and the collection and publication of medical information.

Black-Headed Gull Survey

THE survey of the black-headed gull (*Larus ridibundus*) carried out by P. D. Hollom, with the help of 160 other observers for the British Trust for Ornithology (*British Birds*, Jan. 1939), gives a total number of 70,000 breeding pairs in 124 gulleries in England in 1938 and 6,000 in 34 gulleries in Wales. There were 145 gulleries in Scotland and 39 in Ireland; but it is believed that more birds exist in these two countries, which were not fully surveyed. The larger part of the gull population is in the north of Britain, and although there has been a great increase at many places this century, there were probably larger numbers of gulls in the country a century ago, and at many northern gulleries there has been a decline in recent years. The largest British gullery, at Ravenglass, Cumberland, has 50,000 birds—five times that of the next largest and two thirds of the total gull population of England. There are no gulleries of this species in the Isle of Man, and strikingly few in the counties bordering the Bristol Channel.

Nearly forty per cent of the colonies are twenty miles or more inland from the sea and the highest at 1,925 ft. above sea-level at Greensett Moss, Great Whernside, Yorkshire, formed in 1921, where 200 pairs nested in 1938. The total number of colonies in the British Isles is given as 488, but there is also a very lengthy list of deserted colonies. Some of the gulleries, as the Delamere Forest of Cheshire, date back to the early seventeenth century. There seems to be no truth in the belief that use of these eggs for food during the War of 1914–18 depleted many of the present gulleries and tended to disperse the gulls over a wider area, as this started before 1914 in many instances. Cumberland and Yorkshire are very rich in these gulleries, the former county having 19, many of them on the Solway marshes, and the latter county having 29.

Marriage-Rate in War-time

THE November issue of the *Statistical Bulletin* of the Metropolitan Life Insurance Company of New York contains a review of the course of the marriage-rate during the War of 1914–18 in the countries immediately concerned. With the outbreak of hostilities in 1914 the marriage-rate of all the belligerent countries fell precipitously. In France, for example, the rate dropped from a level of about 8 per 1,000 during the period 1851–1913 to a minimum of 2·3 in 1915. In Germany the pre-war average rate of about 8 per 1,000 sank to 4·1 in 1915 and 1916. In Italy the rate fell to 2·7 in 1917. In England and Wales the rate, which for a long time had been about 8 per 1,000, showed a transient rise to 9·7 in 1915 and then fell to 6·9 in 1917. In the United States the minimum reached in 1918 was not far below an average of 10·4 for 1914–16, the years preceding the entrance of the United States into the war. The end of the War was followed by a prompt rebound to unusually high figures. Thus in France the rate rose from 5·5 per 1,000 in 1918 to 14·0 in 1919 and 16·0 in 1920, and similar though less

pronounced rises took place in Germany and most of the other belligerent countries. Even some of the neutral countries showed a distinct reaction, which in the case of Switzerland was more marked than that of England and Wales.

Rehabilitation of Adult Prostitutes

EXPERIENCE shows that the problem of prostitution tends to acquire particular importance in time of war, not only for the countries directly involved but also for other countries, and the publication by the League of Nations Secretariat of a third and concluding volume of studies on this subject is therefore opportune (League of Nations Pamphlet, iv, 4, Messrs. Allen and Unwin, 40 Museum Street, London, W.C.1 ; 1939. 3*s*. 6*d*. net) An endeavour is made in this volume to elucidate the controversial question of possibilities of reclaiming prostitutes for re-entry into the normal life of the community. Institutional training is discussed at some length, and an account is given of the different approaches made by various types of institutions, religious and lay, to the problem. The Advisory Committee which studied this question came to the conclusion that, if certain principles are applied and certain psychological factors recognized, rehabilitation of adult prostitutes is, within limits, both feasible and successful. The volume should be useful not only to those directly concerned with the problem of rehabilitation, but also to all social workers who have to deal with the very complex question of prostitution in general.

London School of Hygiene and Tropical Medicine

THE report for 1938–39 of the London School of Hygiene and Tropical Medicine, incorporating the Ross Institute, is, as usual, of great interest. It should be realized that studies which seem minute and insignificant, such as the survival and fertility of insects under highly unfavourable conditions, may be of the utmost importance to planters and owners of big estates They should subscribe more generously to a School which does so much for their welfare. The Institute, while busy at home with many discoveries, including bacterial survival for well over a century, has been continuing the attack on the problems of *Anopheles minimus* in Assam, a mosquito which can be controlled more effectively by shading than by the use of drugs.

It is very satisfactory to learn that in the chief field stations of tea estates in India it has been possible to train a staff of Indians as surveyors of malaria and laboratory assistants. The annual malaria control course for laymen which started at the Institute in 1929 is free, and from small beginnings has now attracted more than a thousand learners. Ceylon has had in the past great outbreaks of malaria due to drought, but the failure of two monsoons during the year under survey did not lead to the major outbreak that might have been expected. The Ceylon Government and the Estates Malaria Control scheme confined the trouble to minor eruptions. This is a specimen of the remarkable work that is done. The energies of the Institute are, indeed, far flung. They have been extended to the Gold Coast and the question of mass emigration of refugees from Central Europe to British Guiana. Dr. Chester Beatty's speech at the annual 'Mosquito Day' luncheon dwelt rightly on the comparatively meagre support given. Some of the travelling specialists are constantly employed and clearly overworked.

A New Type of Wood-Burning Stove

A NEW stove, developed by the Connecticut Forest and Park Association in co-operation with Prof. L. E. Seeley, heating expert of Yale University, burns wood with an efficiency estimated at ninety per cent. It is capable of heating two or three rooms and requires filling only once or twice a day. A report issued by Science Service, of Washington, D.C., says that the new heater holds about two and a quarter cubic feet of wood, or slightly more than 50 lb. It is estimated that it will generate about 40,000 B.T.U./hr. for an eight-hour period without attention This amount of heat is sufficient for two or three rooms in cold weather. In mild weather the heater will easily run more than twenty-four hours without attention.

The new heater differs radically in design from the usual type of wood-burning stove Air supply is limited as in any tight heater, but all air is not directed into one space, as is customary ; instead, provision is made for pre-determined amounts of air to enter the combustion chamber, while a separate air supply is allowed to mix with the highly heated gases formed by the burning wood. The wood gases are passed through small passage-ways called combustion ports where they are burned separately from the wood. The process is a partial distillation of the wood producing charcoal and gas, and the products are burned in different spaces. The result is high efficiency with a minimum of loss in soot, creosote and ash. The Governor of Connecticut, who has expressed interest in the establishment of a permanent outlet for the firewood now being wasted in the State for lack of a market, has made possible a small-scale commercial experiment in the use of wood as fuel in State institutions.

Electrical Thawing

DURING the recent cold spell, serious inconvenience has been caused in many households by the freezing of water services In the *Electrical Review* of February 2, a letter from Mr. C. W. Salt, the city electrical engineer to Carlisle, is published describing an effective and easily applied method of thawing frozen water services, when a public A.C. supply is available. In Carlisle, where the voltage is 230, a double-wound single-phase transformer is used, the ratio being 230/12, with a regulating resistance on the primary side and an ammeter scaled 0–250 on the secondary side. The primary is plugged into a 15 amp. radiator socket and the secondary leads are attached to a tap or pipe inside the house and to the stopcock of a neighbouring house. The regulating resistance is adjusted until the secondary current flows through

the frozen pipe at about 150 amp. It is found that the normal ½-in. lead service pipe thaws out in five to seven minutes Mr. Salt says that in cases of sickness where there is no water supply and consequently no kitchen fire or other means of providing hot water, this remedy has been much appreciated.

New Physical Apparatus

Prof. C. J. Overbeck of Evanston University, Illinois, directs attention to some of the recent improvements in apparatus for physical research developed in the United States during the last four years, in a twelve-page illustrated article in the January issue of the *Journal of Scientific Instruments*. He deals with fractionating oil-diffusion pumps of both glass and metal and with the use of sylphon (metal bellows) for producing adjustments in evacuated spaces from outside without interfering with the vacuum. He describes a centrifuge suspended and run in a vacuum, a new apparatus for determining e/m for electrons, and a device for renewing the emitting surface of an oxide cathode. The Bureau of Standards apparatus for attaching to free balloons which signals its records and weighs only 5 lb. is also mentioned. Some examples of the use of Polaroid for stress analysis are given, and a vacuum grating spectrograph for investigating infra-red rotation spectra is described. The advantages of the new synthetic lithium fluoride crystals combined with quartz in a lens doublet, achromatic over a wide range of wave-lengths, are illustrated by spectrograms. References to thirty-one sources of further information are given, and Strong's "Procedures in Experimental Physics" (New York, 1938) is mentioned as of great value for its up-to-date laboratory devices.

Seedlings in Transit: a New Method

Science Service, of Washington, D.C., reports the extensive use of a new and simple method of protecting young seedlings of tomato and cabbage from drying out during transit, which may have considerable importance in Great Britain at the present time Dr. R. N. Du Puis of Chicago suggested that the plants might survive better if the sphagnum in which the roots were wrapped were moistened with a glycerine solution instead of with water. After encouraging large-scale experiments in 1939, the method was brought into commercial use, more than 75 million seedlings being shipped from the south to the north under these conditions. The new method apparently saved much loss from drying out and is also stated to give protection against fungus troubles.

The National Book Council

It was a wise statesman who said that we must educate our masters, the democracy of to-day, and the National Book Council's latest report, 1938–39, is full of a well-backed forward movement with a new Consultative Committee designed to promote more book-reading. At present, the public libraries are used by about 15 per cent of the population, which remain in ignorance of the chances they have to improve their knowledge, or at least get sound information about their hobbies and the special line of reading they prefer. "Four to Fourteen" for young people has already become a standard bibliography, and "Summer Holiday Reading", a select list of new books, has led to demands beyond the large number printed. Such guides through the present overgrown jungle of books are essential to-day.

The 38-page "Catalogue of Books for the Services" is a good and wisely catholic selection, due to the Council and the Society of Authors acting together. It gives learned and popular theology on one page and on another a choice of thrillers by Dorothy Sayers, science, plays, essays, and fiction, old as well as new. We notice one omission in the judicious section of poetry; Kipling's two early books of soldier jingles are included, but where is the "Collected Verse" of his more mature years? That volume holds many well-known pieces and celebrates the work of our Navy with the "Wet Litany", "Mine Sweepers", "The North Sea Patrol" and other vivid things not easily forgotten. Evacuees, both young and adult, have raised new problems of book-supply, in towns and villages unequal to the demand, and the Council has suggested to the Board of Education sound plans to arouse interest and supply the books needed.

Earthquakes in Greece

Strong earthquakes were experienced last week in the town of Ekaterini at the foot of Mount Olympus on the shores of the Gulf of Salonica in Greece. On the morning of February 1, several tremors and one or two earthquakes occurred to the accompaniment of loud and long-continued underground rumbling. Some houses collapsed. On February 2 the shocks continued, there being eighteen in all. About 120 buildings, including some schools, the law courts and the post office, collapsed or became severely damaged. The casualty numbers have not yet been published. Tents have been erected as temporary dwellings and the postal headquarters are reported to be temporarily in a tent. Medical supplies and anti-typhoid vaccines have been sent from Salonica. It will be remembered that a severe earthquake wrecked several villages in the Chalcidice district of Greece on the night of September 27–28, 1932. The epicentre was then estimated to have been between Salonica and Mount Athos (Nature, October 8, 1932, p. 537), which is to the north-east of the present epicentres.

Earth Tremors in Scotland

Slight earth tremors are reported to have occurred on February 3 at Stirling in Scotland. No damage has been done. The tremors may have been occasioned by slipping along a local fault. Similar tremors were reported from Roslin, near Edinburgh, on February 10, 1934, though the most active region seismically in Scotland is near Comrie in Perthshire, where the slight tremors are considered to be due to slipping along the Highland Boundary Fault system.

Other Recent Earthquakes

SEVERAL severe earth tremors and moderate to strong earthquakes have also been experienced recently in widely separated areas in Italy. On January 25 a severe tremor was felt at Genoa in Italy. This did no damage. On February 1, early in the day, a severe earthquake shock caused considerable damage to the famous cathedral town of Siena in Italy. A less severe shock was felt at Florence, and, presuming it was the same earthquake, the epicentre was close to Siena (lat 43° 20′ N., long. 11° 20′ E.) On the same morning three shocks were felt in Bucharest, in Rumania. No damage was done. The epicentre of this earthquake was estimated in Bucharest to have been in the Black Sea, five hundred miles east of Bucharest

Earthquake Recorded on Magnetograph

IN *Earthquake Notes*, the publication of the Eastern Section of the Seismological Society of America (11, Nos. 1 and 2, September 1939), it is stated that the earthquake with epicentre latitude 20·8° N., longitude 66·0° W. on June 12, 1939, which was felt in San Juan, was recorded at the San Juan Magnetic Observatory. The recording was on the magnetograms of both the declination and the horizontal intensity instruments, but there was no trace of a disturbance on the vertical intensity magnetogram.

Francis Amory Septennial Prize

IN compliance with the provisions of the will of the late Francis Amory, the American Academy of Arts and Sciences, as trustee of a fund given by the testator, announces a prize to be known as "The Francis Amory Septennial Prize", to be awarded for conspicuously meritorious work performed during the immediately preceding septennial period, "through experiment, study or otherwise, in the treatment and cure of diseases and derangement of the human sexual generative organs in general, and more especially for the cure, prevention or relief of the retention of urine, cystitis, prostatitis, etc." If any work of quality warrant it, the first award will be made in 1940. The total amount will exceed 10,000 dollars, which may be divided at the discretion of the Academy among several nominees While formal nominations are not expected and no essays or treatises in direct competition for the prize are desired, suggestions are invited Communications should reach the Francis Amory Septennial Prize Award Committee not later than May 15, 1940, and should be addressed in care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass., U.S.A.

Paris International Trade Fair

THE thirty-second annual Paris International Trade Fair will be held during May 11–27. The international aspect of the Fair will be developed to an even greater extent this year. Already national sections have been promised from Italy, Holland and Spain, as well as the usual displays from Switzerland, Belgium, etc. In deciding to hold the Fair this year at the Porte de Versailles, the Committee and exhibitors alike are showing the same courageous spirit as in 1917, when a similar decision was made although the German trenches were only 100 kilometres from the Capital.

An Inventions Competition is being organized, as usual, in connexion with the Fair. Last year 769 inventions were submitted by 517 competitors, representing fifteen countries. The value of the prizes this year will be 25,000 francs, as on previous occasions. In addition, there will be a number of medals, diplomas and prizes Application forms, obtainable from the London office of the Fair at 17 Tothill Street, S.W 1, or direct from 23 rue N.D. des Victoires, Paris 2, must be returned not later than March 31.

Lectures at Marx House, London

THE spring programme of lectures to be given by the Faculty of Science, Marx House, Clerkenwell Green, E.C.1, begins on February 12 when Prof. J. B. S. Haldane will give the first of a series of five lectures on "How the Human Body Works". In this course, which will run on consecutive Mondays at Marx House, Clerkenwell Green, at 7.30 p.m., Prof Haldane will deal with "Is Man a Machine?" "Blood", "Digestion and Excretion", "The Nervous System" and "The Regulation of Bodily Functions". On February 16, Dr P. Dienes will give the first of five lectures on "The Science of Thinking", in which he will deal with logic and arithmetic. These lectures, which will be at the University Labour Club, 15 Percy Street, W.1, will be held on consecutive Fridays at 8 p.m. Prof. J. D. Bernal is also to give a lecture, followed by a discussion, on "The Structure of Matter" on March 3 Further information can be obtained from the Secretary, Marx Memorial Library and Workers' School, Marx House, Clerkenwell Green, E.C.1.

Announcements

THE National Association for the Prevention of Tuberculosis has decided to devote its activities in war-time chiefly to propaganda and the care and rehabilitation of tuberculous patients and their families.

PROF. JOHN F. FULTON, professor of physiology in the Yale University School of Medicine, has been requested by Mrs. Cushing to write a biography of her husband, the late Dr. Harvey Cushing. Dr. Fulton will be grateful for letters, anecdotes or other pertinent material available.

THE Langley memorial prize, value £21, is open for competition among officers of the Colonial Medical Service who are serving or have served in West Africa, and will be awarded for the best paper on one of the following subjects: (*a*) tropical medicine or surgery, (*b*) tropical hygiene and sanitation, (*c*) tropical entomology and parasitology. Papers, which may consist of published or unpublished work, should be sent to the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, by October 1.

LETTERS TO THE EDITORS

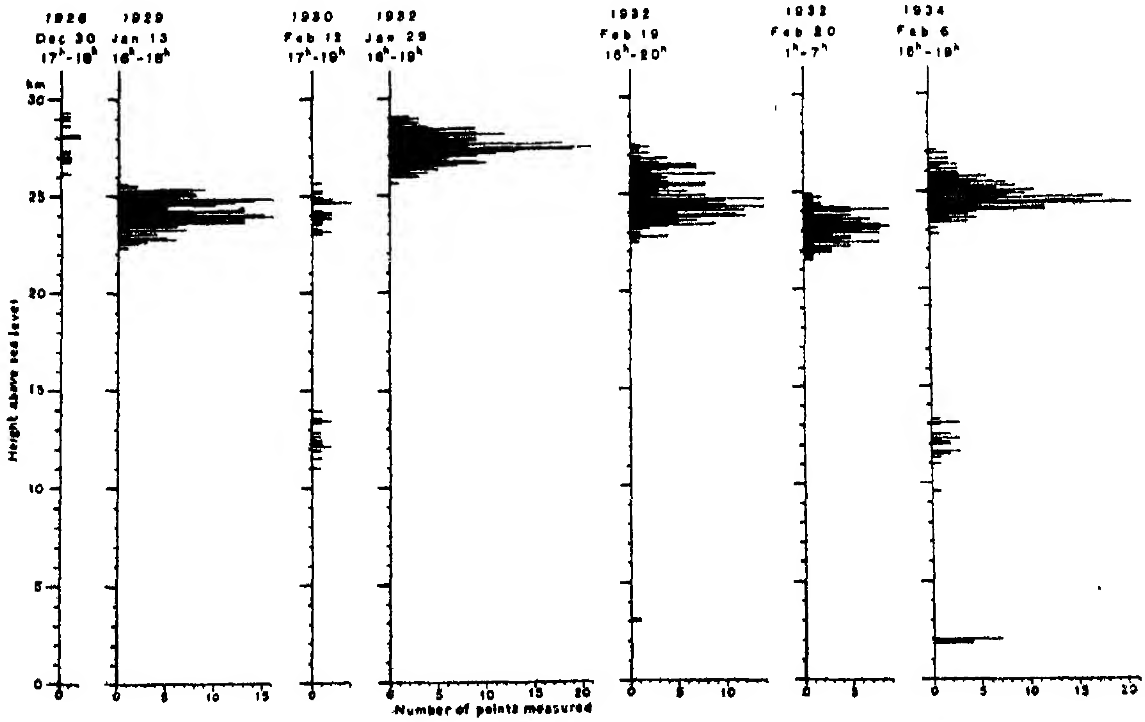
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 228. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Height of Mother of Pearl Clouds observed in Southern Norway during 1926-34

IN two letters in NATURE[1,2] I gave the first results of the photographic height measurements of the mother of pearl clouds over southern Norway The whole material obtained in the years 1926, 1929, 1930, 1932 and 1934 is now worked out and a detailed report will be given in *Geofysiske Publikasjoner*, Oslo The results of the 1,122 measurements of height are given in the accompanying diagram.



For each date we have chosen as abscissa the number of cases for each given height, and as ordinate the height in kilometres. The time is central European time.

As will be seen, the height was greatest on December 30, 1926, mean 27·7 km., and on January 29, 1932, mean 27·4 km. Of special interest is the fact that the clouds during the night of February 19–20, 1932, were lower down than in the afternoon on February 19, with a difference of 1·6 km. between the means.

MOTHER OF PEARL CLOUDS

	1926 Dec 30	1929 Jan. 13	1930 Feb 12	1932 Jan. 29	1932 Feb 19	1932 Feb 20	1934 Feb 6
P	2	38	7	42	44	29	24
N	15	235	28	238	253	138	215
H	27 7	24 1	24·0	27·4	24 8	23 2	24 7

On February 12, 1930, and February 6, 1934, cirrus clouds were lying under the mother of pearl clouds, as indicated in the diagram The altitude of these cirrus clouds was rather great, being 11–14 km. On February 6, 1934, they were arranged in great waves. For such a wave, the distance between the bottom and crest was measured and found to be 20 km., and the vertical difference about 1·5 km. Still lower down, at 2–3 km., fracto-cumulus clouds were observed on two occasions drifting with the Föhn wind towards the south-east.

In the above table a summary is given. Here P is the number of sets measured, N the number of measured points, H the mean height in kilometres.

The velocity of the clouds was 75 metres a second on December 30, 1926, towards the south-east, but on the other occasions rather small, 10–20 metres a second in the same direction. The astronomer Sigurd Einbu has written to me that he observed mother of pearl clouds from Dombaas on February 16, 1934, which moved towards the south-east with a velocity of 90 metres a second, the height being supposed to be 25 km.

A series of forty-one successive pictures of a cloud on January 29, 1932, showed rapid changes probably due to turbulence with successive evaporations and condensations in the layer from 26 km. to 28 km.

As already remarked in my former letter in NATURE[2], measurement of a corona round the moon in the night of February 19–20, 1932, led to a diameter of the particles of the cloud not exceeding 0·0025 mm.

Series of observations of mother of pearl clouds were also received from northern Scandinavia and from Finland.

As to the accompanying meteorological conditions, they were the same as those described by H. Mohn in a paper in 1893[3].

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[1] NATURE, 123, 260 (1929)
[2] NATURE, 129, 941 (1932)
[3] Mohn, H., "Irisierende Wolken", *Meteor. Z.* (March 1893).

Wireless Propagation and the Reciprocity Law

THE theorem of reciprocity has been expressed in several different forms, notably by Rayleigh[1] and by Sommerfeld and Pfrang[2]. The form most directly related to wireless wave propagation has been given by Carson[3], as follows:

If an E.M.F. is inserted in the transmitting branch of antenna A_1 and the current measured in the receiving branch of antenna A_2, then an equal current (both as regards amplitude and phase) will be received in the transmitting branch of A_1 if the same E.M.F. is inserted in the receiving branch of A_2.

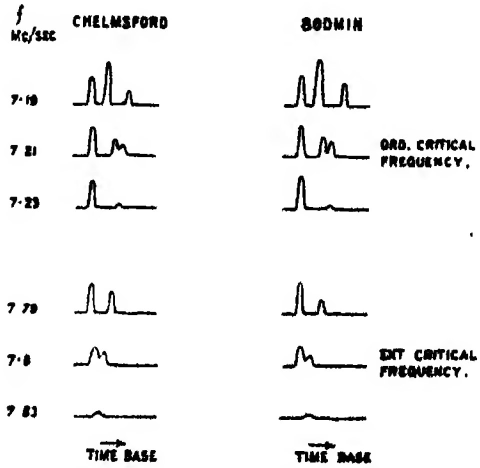
The extent to which this theorem applies to waves propagated in the ionosphere has been much discussed. The presence of the earth's magnetic field renders the medium anisotropic, so that the arguments on which the theory is based are no longer applicable. In practice, the theory is of importance in deciding whether transmission from one station to a distant one is as 'good' as that in the reverse direction. Measurements made in 1922 on long waves[4] suggested that this was not always the case; but much more data would be required to provide a complete check.

Recently we have made tests on two-way transmission between Chelmsford and Bodmin (distance 393 km.), using pulses in each direction. Provision was made for varying the frequency of both transmitters, and for observing at each station on a cathode ray tube the 'echo pattern' due to the distant transmitter. Some interesting results concerning the reversibility of the waves have been obtained by this means.

Experiments were made in which the frequencies of the two transmitters were varied together in small steps over a range embracing the critical frequency of the F layer (for oblique reflection).

On each frequency the echo pattern was observed at the two stations, and the exact point of disappearance of the signal was thus determined. The results at the two ends were then compared. The experiment was repeated a large number of times, and was carried out covering the critical frequencies of both the ordinary and extraordinary waves.

The results obtained were of the type shown in the accompanying figure. Each critical frequency is marked by the convergence of two rays, a high and a low angle[5], and the final point of disappearance of each could be estimated to an accuracy of about 0·02 Mc./sec. They show a remarkable agreement between the critical frequencies for propagation in the two opposite directions, this being equally true for either magneto ionic component: the frequencies can be said to be within 0·03 Mc./sec. for the two directions in either case.



The results are thus consistent with reciprocity and prove that in this particular case the observed effects are what, indeed, would be deduced from this principle. They do not prove that this is true in the general case; but it is notable that the critical trajectory we have observed is one which is highly sensitive to the properties of the refracting medium, and the exact agreement found suggests that in other conditions too the behaviour of waves propagated in the ionosphere is the same for one direction of transmission as for the other. The practical importance is perhaps the greater, for in long-distance communication between two stations one limiting condition for reception of a signal is that the receiver shall be outside the skip zone. This condition is identical with that referred to above, as applied to the extraordinary wave, this wave being the last to escape through any ionospheric layer. Thus it is clear that, so far as electron limitation is concerned, if transmission is possible for one direction of travel between two stations, it is necessarily possible in the opposite direction.

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Marconi's Wireless Telegraph Co., Ltd.,
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[1] Rayleigh, "Theory of Sound".
[2] *Z. hochfreq. Tech.*, 26, 93 (1925).
[3] *Proc. Inst. Rad. Eng.*, 17, 952 (1929).
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[5] *Proc. Phys. Soc.*, 50, 956 (1938).

Energies of β-Particles from Uranium-X_2

THE end point energy of uranium-X_2 given in "Tables Annuelles de Constantes" is 1·66 Mev.[1] (from Wilson chamber measurements) in contradiction to the values found previously by absorption methods[2,3] and magnetic focusing[4].

At first sight, the Wilson chamber measurements might be considered more accurate than absorption methods, and an apparent end-point of 1·6 Mev. was obtained in this Laboratory from measurements of the curvature of β-ray tracks in a Wilson chamber (Fig. 1). However, when the energy spectrum of a very thin film of uranium-X_2 was measured with a magnetic spectrometer and coincidence counter[5], the spectrum given was as in Fig. 2, with an end point at 2·3 Mev., in agreement with the absorption and magnetic focusing values. The use of the spectrometer gives, of course, much greater accuracy than the other methods, and, incidentally, entails far less work than the Wilson chamber method.

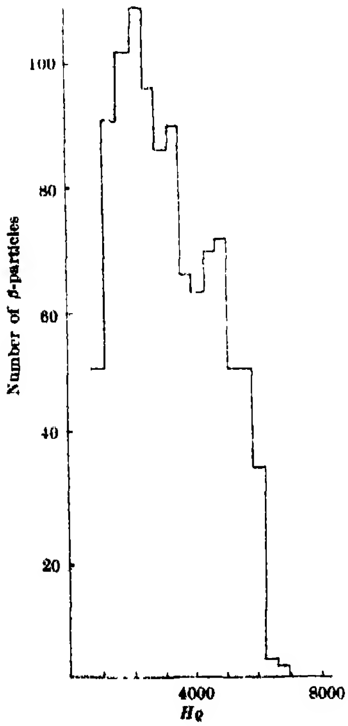
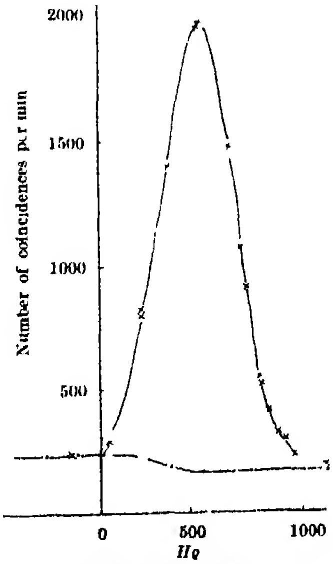


Fig. 1



— x — x, uranium-X_2 points, — · — , background with lead shutter over slit

Fig. 2

In view of the discrepancy between the measurements obtained by this accurate method and those obtained by the Wilson chamber method, energy spectra derived from the latter should evidently be accepted with reserve.

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[1] "Tables Annuelles", 12, 13 (1938).
[2] Sargent, *Proc. Roy. Soc.*, A, 139, 659 (1932).
[3] Feather, *Proc. Camb. Phil. Soc.*, 34, 115 (1938).
[4] Ward and Gray, *Canadian J. Research*, 15, 42 (1937).
[5] Roaf, *J. Sci. Inst.*, 17, 17 (1940).

Determination of h/e by the Method of Isochromats

IN recent years several determinations of h/e from the short wave-length limit of the continuous X-ray spectrum have been made. The results obtained from this method, however, disagree definitely with the value of h measured by other methods. According to Kirchner[1] the most accurate determinations of h/e by the method of isochromats give $h = 6{\cdot}614 \times 10^{-27}$ erg sec., provided $e = 4{\cdot}803 \times 10^{-10}$ E.S.U., $e/m = 1{\cdot}759 \times 10^{7}$ E.M.U./gm. and $R_\infty = 109{\cdot}737$ cm^{-1}. This discrepancy has not yet been explained. Also the shape of the isochromats, especially in the vicinity of the short wave-length limit, causes a problem. Instead of running straight down to zero, thus giving a sharp radiation limit, the isochromats run asymptotically down to zero. This 'foot' of the curve indicates that some electrons hit the anticathode with a velocity which is greater than that corresponding to the voltage applied on the X-ray tube. Various hypotheses have been put forward to account for the existence of such electrons

For some time back, I have been investigating the short wave-length limit in order to determine h/e. As a preliminary result of the investigation, it has been found that the phenomenon mentioned above seems to be a simple effect of the vacuum in the X-ray tube. Thus a pressure of 5×10^{-4} mm. of mercury in the tube gives isochromats of the usual shape, but if the pressure is diminished sufficiently, this shape will change. A pressure of $1{\cdot}5 \times 10^{-5}$ mm. of mercury gives an isochromat, which runs straight down to zero, thus giving a sharply marked short wave-length limit. Further, the isochromat is slightly displaced towards higher voltage, corresponding to a higher value of h/e. This influence of the pressure in the X-ray tube upon the shape of the isochromats may be explained as an effect of gas ions generated by the electron current in the tube. These ions release secondary electrons from the cathode, some of which have a velocity component directed towards the anticathode. Hence these electrons hit the anticathode with a correspondingly greater velocity.

In any event it seems necessary for an accurate determination of h/e to give greater attention to the vacuum than has been done in previous investigations.

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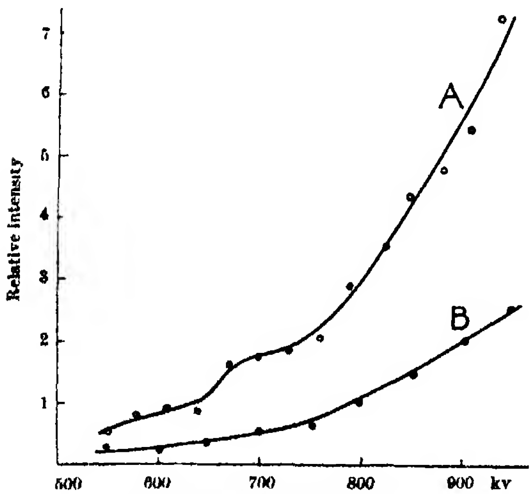
[1] Kirchner, F., *Ergebn. exakt. Naturwiss.*, 18, 26 (1939).

Bombardment of Nitrogen and Oxygen with Protons

A REACTION of considerable interest in connexion with Bethe's theory of energy production in the stars[1] is that involving the capture of protons by the isotope of nitrogen ^{14}N.

$$^{14}N + {}^{1}H \rightarrow {}^{15}O + h\nu, \quad . \quad . \quad . \quad (1)$$

since this process is one of those involved in his cyclical scheme of nuclear processes. The occurrence of this process was detected by measuring the radioactivity produced in targets of sodium nitride (found to be one of the few compounds of nitrogen that is stable under bombardment). The period of the radioactivity was two minutes, in agreement with the known value[2] for ^{15}O, and the excitation function for the reaction is as shown in Curve *A* in the accompanying graph. Some slight evidence of resonance features is present, but the low yield of the active product prevented very accurate measurement. The yield was found to be $1 \cdot 5 \times 10^{-11}$ positrons per proton of energy $0 \cdot 96 \times 10^{6}$ ev.



Curve *A* target of sodium nitride
Curve *B* target of aluminium oxide

Experiments were carried out to show evidence of the process involving the heavier isotope, ^{16}O,

$$^{15}N + {}^{1}H \rightarrow {}^{16}O + h\nu, \quad . \quad . \quad . \quad (2)$$

but without success. The use of targets of nitrogen specially enriched with ^{15}N might produce information concerning reaction (2).

Curve *B* shows the excitation function of ^{17}F of period 70 seconds, formed according to

$$^{16}O + {}^{1}H \rightarrow {}^{17}F + h\nu. \quad . \quad . \quad . \quad (3).$$

This was measured in the course of the above experiments but is a result of value in itself. The curve exhibits no special features and the cross-section for the reaction at low proton energies is extremely small. The measured yield was $8 \cdot 0 \times 10^{-15}$ positrons per proton at 950 kv. This small yield explains the fact that the threshold for the reaction has been given previously[3] as $1 \cdot 4 \times 10^{6}$ volts.

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[1] Bethe, *Phys. Rev.*, **55**, 434 (1939).
[2] McMillan and Livingstone, *Phys Rev.*, **47**, 452 (1935).
[3] Du Bridge, Barnes and Buck, *Phys. Rev.*, **51**, 995 (1937).

Flame and Arc Spectra of some Calcium and Strontium Salts

A STUDY of the flame and arc spectra of chlorides, nitrates and oxides of calcium and strontium, in the first order of 10 ft., and 21 ft., gratings, indicates that the spectra of the halides are mixed up with those of the oxides, particularly in the strontium salts; the mixed spec ra appear to be present even in spectrograms taken for the halide with arc in an atmosphere of hydrogen[1]. This has caused many bands due to the oxide to be mistaken for SrCl bands. The anomalous doublet separation (~ 600 cm.$^{-1}$) observed[2] in SrCl seems to be due to such a complicated disposition of the oxide and halide bands. If the oxide bands are fully eliminated, it appears possible to arrange the bands in a system with a doublet separation of the order of 260 cm.$^{-1}$, which is a reasonable extrapolation for the expected doublet level. Work is in progress and a detailed description of the spectra will be published elsewhere.

We would, however, like to note another interesting characteristic feature of these spectra. Calcium salts give a narrow group of bands at 5552·4 A. shaded towards shorter waves, followed by an unresolved bright continuous patch, the intensity being high in the flame and low in the arc. This is the band also recorded by Eder and Valenta[3]. Similarly, the spectra of strontium salts show a number of weak and strong bands shaded towards shorter waves, starting from 6113·7 A., followed by an unresolved bright continuous doublet patch with maxima at 16499 cm.$^{-1}$, and 16548 cm.$^{-1}$, which again is weak in the arc. While the details of the structure of the bands cannot, at the moment, be fully explained, it seems likely that these bands are due to the metal molecules Ca_2 and Sr_2, and that the electronic transition responsible for band emission involves a lower electronic state with a shallow minimum characteristic of a van der Waals type of molecule. The bands start in calcium and strontium at 18005 cm.$^{-1}$ and 16352 cm.$^{-1}$, while the $^3D_2$ states of the two atoms[4] are 20371 cm.$^{-1}$ and 18320 cm.$^{-1}$ respectively above the ground levels.

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[1] Parker, A. E., *Phys Rev.*, **47**, 349 (1935).
[2] Hedfeld, K., *Z. Phys.*, **68**, 610 (1931).
[3] Eder, J. M., und Valenta, E., "Atlas Typischer Spektren" (Wien, 1928).
[4] Bacher, R. F., and Goudsmit, S., "Atomic Energy States" (New York, 1932).

Red-Shifts in Nebular Spectra and Scientific Practice

IN a recent issue of NATURE[1], Dr. K. R. Popper discusses various interpretations of the nebular redshifts. He asserts that "as basis of a measuring system for cosmological purposes" we may use, for time measurement, "*AC* (atomic clocks)" or "*LC* (light clocks)", implying the constancy of atomic frequencies and the velocity of light respectively;

and, for space measurement, "*MR* (material rods)" or "*LR* (light rods)". Three combinations of these 'instruments' are possible: $AC + MR$; $AC + LR$: and $LC + MR$; and Dr. Popper proceeds to show that the corresponding interpretations of the red-shifts are "logically equivalent, and therefore do not describe alternative *facts*, but the same facts in alternative *languages*".

I have not attempted to follow the arguments in detail because it is immediately clear that if the basis of measurement is granted the logical equivalence follows. What I wish to point out, however, is that that basis is itself baseless, since 'atomic clocks' cannot be used for measurement In order to establish the accuracy of a time-measuring instrument and so make it usable, we must be able to check its readings. The 'light clock' scale allows us to do this: we can take any ordinary clock, and regulate it so that the hand moves over the same number of divisions on the dial on every occasion on which a beam of light travels from a given point to another and back. But we cannot similarly use the 'atomic clock' scale because we cannot know the frequency of an atom without measuring the wave-length and velocity of its radiation, and to do this we must already have a clock. (An alternative process would be to measure the energy of radiation and use the equation $E = h\nu$, but, apart from the practical impossibility of measuring the energy of a single photon, we still need an antecedent clock to measure E, and we must, in addition, assume the validity of the equation) AC must therefore be rejected, and the only one of Dr Popper's combinations which survives is $LC + MR$.

I think we have here another example of a very dangerous tendency in modern physics, to which I have previously directed attention[2]; namely, a retreat from experience into the world of pure logic. It appears that if two languages are logically equivalent it does not matter that one of them cannot be spoken. Moreover, the choice of 'languages' is remarkable. We *cannot* use an atomic clock; we *do not* use a light clock; and the rotating material body (corrected, if necessary, in a specified way for long-period measurements[3]) which we actually *do* use is not even mentioned. The outstanding value of the theory of relativity was that it awoke us to the consciousness that the only way to progress in science is to apply our logic strictly to experience, and to experience alone. It is to be feared that the stimulant has become a narcotic: we are fast asleep again.

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[1] NATURE, 145, 69 (1940).
[2] NATURE, 139, 784 (1937)
[3] NATURE, 144, 888 (1939)

Distributional Stability

CONSIDER a conservative dynamical system with n degrees of freedom for a fixed value of the energy constant. Suppose that the corresponding $(2n - 1)$-dimensional energy surface, S, has a finite $(2n - 1)$-dimensional volume measure. Through every point P of S there is a solution path; its point belonging to the time t will be denoted by P_t. According to the classical definition of Lagrange and Dirichlet, the solution path P_t, $-\infty < t < +\infty$, is called stable (with reference to the isoenergetic system), if the distance between the points P_t and Q_t remains arbitrarily small along the infinite t-axis whenever the initial position Q is sufficiently close to P.

The results of the efforts of the last sixty years, as represented by the geometrical investigations of Poincaré, Hadamard, Levi-Civita and Birkhoff, are to the disappointing effect that this classical notion of stability must be considered as a rather exceptional phenomenon, a phenomenon which can practically never occur, unless the solution is a solution of equilibrium, that is, unless P_t is independent of t. The reasons may be roughly stated to be Diophantine in nature, and are formally represented by the appearance of an irrational rotation number in the geometrical theories of periodic motions, and, equivalently, by the celebrated 'small divisors' in the theory of astronomical perturbations. Actually, the extreme scarcity of motions which are stable in the classical sense cannot be surprising from a dynamical point of view. In addition, this notion of stability has scarcely anything to do with the needs of statistical mechanics. In order to take care of these needs, I propose a notion of stability based on the idea of asymptotic distributions, thus eliminating the anomaly that practically no motion of any system is stable

One is naturally led to this notion of distributional stability by restating the ergodic theorem of Birkhoff[1] in such a way as to make it free of arbitrary functions. Then the ergodic theorem states that if the initial position P on S does not belong to a certain set of vanishing volume measure, the corresponding path P_t will possess an asymptotic distribution function. By this is meant that if V is any small 'cube' $(-\varepsilon < x_i - a_i < \varepsilon)$ in $S = (x_i)$, there exists an *asymptotic* probability, say, $\varphi = \varphi_P(V)$, that the point P_t of the path belonging to P be in V; provided that the hyperplanes determined by the faces of the cube V do not belong to an enumerable sequence of hyperplanes[2] In other words, there exists for every such cube V, and for every path P_t which does not belong to initial positions P forming a certain set of vanishing volume measure, a well-determined asymptotic amount of time, $\varphi = \varphi_P(V)$, spent by the path P_t in the subdomain V of S. In addition[3], it was recently shown that this asymptotic probability $\varphi = \varphi_P(V)$ is distinct from zero whenever the path P_t belonging to P penetrates at least *once* the arbitrary subdomain V of S. The function $\varphi_P = \varphi_P(V)$ of the variable subdomain V of S may be considered as describing the asymptotic distribution of the path P_t belonging to the initial position P. Obviously, $\varphi_P(S) = 1$ for every P.

It now appears that a notion of stability which is adequate from the point of view of statistical mechanics is the following: The path P_t in S has distributional stability if the asymptotic distribution function φ_Q tends to the asymptotic distribution function φ_P whenever the initial position Q of the path Q_t tends to the initial position P of P_t. It is understood that this convergence to $\varphi_P = \varphi_P(V)$ is required for *every* V of the type specified above; and that points P and Q belonging to the excluded set of vanishing volume measure must be omitted.

The conditions of this definition are such as to be satisfied not merely in exceptional cases, and are compatible with the Diophantine intricacies alluded to above. In fact, it is easy to see that all motions of every system of the integrable type of Liouville-Stäckel satisfy this condition (but not, of course, the

stability requirement of Lagrange-Dirichlet). In addition, the conditions are satisfied in the other extreme case of complete *non-integrability*, as represented by the case of metric transitivity, a case underlying the classical ergodic hypothesis of statistical mechanics. In fact, this case is characterized by the condition that $\varphi_P(V)$ be always the ratio of the volumes of V and S; so that, in particular, $\varphi_P(V)$ is independent of P.

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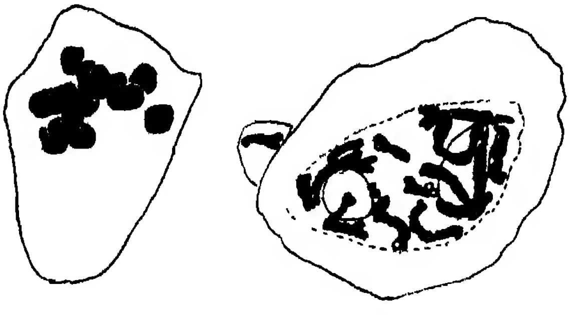
[1] Birkhoff, G. D., *Proc. Nat. Acad. Sci.*, **17**, 656–660 (1931).
[2] Wintner, A., *Proc. Nat. Acad. Sci.*, **18**, 248–251 (1932).
[3] Wintner, A., and Hartman, P., *Amer. J. Math.*, **61**, 977–984 (1939).

Genetical Sterility in Pisum sativum

COMPLETELY sterile plants were observed by Miss Pellew in the offspring of a plant chimærical for structural hybridity. The fertile and half-sterile branches both gave a certain proportion of sterile plants. This character has been further studied in material kindly supplied to us by Miss Pellew. The sterility, which is occasioned by a complete failure of pairing at meiosis, is present on both male and female sides. Illustrated are two stages in meiosis from the ovule showing in Fig. 1*a*, metaphase I with 14 univalents, and in Fig. 1*b* prophase II after a 13 : 1 distribution of chromosomes. The general behaviour at meiosis would appear to be similar to the case reported for Datura by Bergner, Cartledge, and Blakeslee[1]. The character is inherited as a recessive, the following segregation values having been obtained from semi-sterile F_1's: 73 semi-steriles; 57 fertiles; 33 steriles, and from fertile F_1's: 29 fertiles; 14 steriles. Five out of eight fertiles, and seven out of ten semi-steriles tested were found to be heterozygous for sterility. Sterility may be due to a single gene, but it is more probable, in view of its origin, that a complex of genes, due to a deficiency or duplication associated with the reciprocal translocation, is involved. This is being further investigated.



a *b*

Fig. 1 (× c. 2100)

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[1] Bergner, A. D., Cartledge, J. L., and Blakeslee, A. F., *Cytologia*, **6**, 19–37 (1934).

A Pigmented Nucleus

IN the course of our work on growth-promoting substances, we have cultured many different kinds of pollen tubes as test subjects during the last two years. We discovered a very unusual kind of nucleus in the tube of *Hymenocallis tubiflora*. The germinal nucleus is naturally pigmented and is of a reddish-brown colour. This was particularly fortunate for us because it permitted us to follow changes in form and position of the nucleus in the various stages of germination, from the time that the grains were sown, up to the time when the well-developed tube burst at the tip and the nucleus emerged and came to lie free on the surface of the culture medium. The favourable colour made it easy to photograph the nucleus in different phases while it was alive.

So far as we are informed, no previous mention of a pigmented nucleus has been made.

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Mechanism of the Enzymatic Phosphorylation of Thiamin

WE have previously demonstrated that thiamin pyrophosphate may be synthesized from the free vitamin by the action of enzymes present in alkaline washed brewer's bottom yeast, provided that hexosediphosphate and certain factors present in boiled aqueous extracts of animal tissues are present[1,2]. Synthesis under these conditions was completely inhibited by 0·005 *M*. sodium iodoacetate, but was relatively unaffected by 0·04 *M*. sodium fluoride. More recently[3], we have demonstrated that cozymase and acetaldehyde may be substituted for the boiled tissue extract with no change in the degree of synthesis or of the iodoacetate inhibition. Phosphoglyceric acid may also be substituted for the boiled tissue extract, but under these conditions iodoacetate fails to affect the synthesis while fluoride causes complete inhibition[3]. Using specially prepared alkaline washed yeast, we have found that cocarboxylase synthesis with phosphoglyceric acid is considerably diminished. It may be restored, however, by the addition of catalytic quantities of adenylic acid. As a result of these experiments we have proposed the reaction

adenosinetriphosphate + thiamin → adenylic acid + cocarboxylase

Experiments performed in an attempt to test this equation directly showed that synthesis may be performed with adenosinetriphosphate, but only after a lag of 40–60 minutes. The velocity of the synthesis in the presence of phosphoglyceric acid is considerably greater. The degree and velocity of the synthesis with adenosinetriphosphate may be stimulated by the addition of cozymase, and it is inhibited by iodoacetate. These results may be explained by the finding that glucose inhibits the synthesis of cocarboxylase in the presence of phosphoglyceric acid and adenylic acid. The poor synthesis with only added adenosinetriphosphate may be explained on the basis of the competition of other phosphate

acceptors present in the alkaline washed yeast with thiamin for the available phosphorus. The greater and more rapid synthesis in the presence of phosphoglyceric acid is due to the ability of this compound to regenerate adenosinetriphosphate from adenylic acid. The stimulatory effect of cozymase on the synthesis in the presence of added adenosinetriphosphate is due to the fact that in the presence of these compounds carbohydrate present in the alkaline washed yeast is broken down with the resynthesis of adenosinetriphosphate. The inhibitory effect of iodoacetate upon the synthesis in the presence of adenosinetriphosphate is due to the inhibition of carbohydrate breakdown.

The degree of cocarboxylase synthesis under our conditions appears to be limited by the saturation of the carboxylase enzyme[3]. In addition, the competitive effect of phosphate acceptors present in the alkaline washed yeast appears to be so great that more than 200 micromoles of phosphoglyceric acid may be fermented with the production of only 3 micrograms of cocarboxylase.

Weil-Malherbe[4] has recently employed a soluble yeast protein freed from thiamin pyrophosphate for experiments upon the synthesis of cocarboxylase Under these conditions he has secured results which appear to be similar to those obtained in our laboratory.

We are indebted to H. von Euler and F. Schlenk for a sample of pure cozymase and to Prof. C F. Cori for adenosinetriphosphate.

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[1] Lipschitz, M. A., Potter, V. R., and Elvehjem, C. A, *Biochem J*, **32**, 474 (1938)
[2] Lipschitz, M. A., Potter, V. R., and Elvehjem, C. A., *J Biol Chem*, **124**, 147 (1938).
[3] Lipton, M. A., and Elvehjem, C. A, *Cold Spring Harbor Symposia on Quant. Biology*, **7** (1939).
[4] Weil-Malherbe, H, *Chem. Ind.*, **58**, 1021 (1939)

Hydration of Stearanilide

A PHENOMENON of some interest was observed during the preparation of stearanilide. The finished product, recrystallized from absolute alcohol and from chloroform, melted at 93° C. When recrystallization from alcohol was being carried out, a portion of the alcoholic solution was poured into a large excess of cold water. A white material of much greater bulk than the dissolved stearanilide was thrown down. Initially of a gelatinous character, it became granular on standing. It was filtered off at the pump, washed with water, and dried *in vacuo* over fused calcium chloride for ten days. After drying, the material consisted of an amorphous white powder, dry to the touch and easily crumbled between the fingers. The powder had no definite melting-point but decomposed quite sharply at 88°–89°, yielding a drop of colourless liquid and a white solid. This white solid melted at 92°–93°.

A more detailed investigation was then carried out. Weighed samples (1–2 gm. each) of the amorphous white powder were heated to constant weight in ovens at different temperatures. In the accompanying table are recorded the oven temperatures, the hours of heating required to achieve constancy in weight, and the percentage loss in weight:

Temperature	Hours	% Loss in weight
55°	14	79·8
80°	9 5	79 1
90°	3 5	79 1

When drying was complete the residue in every case melted at 93° C.

Thus after drying *in vacuo* over fused calcium chloride for ten days the powder contained almost 80 per cent water. It is suggested that the powder is a hydrated form of stearanilide. The existence of such material is remarkable, as stearanilide is generally described as being very hydrophobic. Calculation shows that, in the material examined, about eighty water molecules were associated with one molecule of stearanilide.

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Jan. 10.

Lyell's Geological Texts

RECENTLY, while referring to Charles Lyell's "Elements of Geology", it was found that the Yale Library copy, of date September 12, 1839, had been sent by the publishers to Benjamin Silliman. This was the first American edition from the first London edition as published by Kay Bros., Philadelphia, with 316 pages and 295 figures in the text. After one hundred years this fine text, one of the world's great books, should again be noted. Earlier, the same publishers had brought out an American edition of Lyell's "Principles of Geology", as was duly noted by Silliman in his *Journal* (now the *American Journal of Science*) at the time. Quoting: "Lyell has done much to recall geologists from extravagant speculations, and to allure them back to a course of strict induction; thus placing Geology side by side with the other sciences of observation".

Nevertheless, after several tens of years advance in geology there came Huxley's famous fling: "Geologists had imagined that they could tell us what was going on at all parts of the earth's surface during a given epoch; they have talked of this deposit as being contemporaneous with that deposit, until from our little local histories of the changes at limited spots of the earth's surfaces they have constructed a universal history of the globe as full of wonders and portents as any other story of antiquity". As justly though, Huxley admitted that, "It was Lyell who had smoothed the road for Darwin".

Re-reading the "Elements" and "Principles" to-day leaves the same fine impression of clarity and of lucidity that proved so arresting one hundred years ago. So much is this true that it would seem that any university student who now finds difficulty in following the subject of geology would get from even a brief, if attentive, reading of Lyell's famed texts the sure initial stimulus so helpful in any far-set or over-strange subject. There blaze the colours of the sunrise of the first real hundred-year day in geology. Starting thus aright, and coming down through that day, the student may the better scan the shadows of that far-set twilight land perhaps destined to be lighted clearly during the second century of geology.

In the "Elements" (p. 57) there are curious notes on the subject of petrifaction, telling of the palæobotanist Goeppert's attempt to "imitate the process" of replacement, by steeping animal and vegetal substances in waters holding siliceous, calcareous, or metallic matters. Strange, indeed, that after a hundred years such an entrancing problem should be as far from a forthright solution as ever.

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Jan 11.

Antimony Treatment of Kala-Azar

SIR LEONARD ROGERS has recently pointed out[1] the value of antimony in the treatment of kala-azar. We note that all his examples refer to India, China and the Mediterranean, and we would point out that these happy results do not apply to kala-azar in the Anglo-Egyptian Sudan.

Since the early failures reported by Archibald[2] in cases treated on the lines advocated in India, it has been the experience of the majority of British medical inspectors working in kala-azar areas that the immediate results, though apparently successful in many cases, are no criterion of final cure, as a considerable proportion of cases relapse within two years. There is also evidence to indicate that such relapsed cases are very resistant to further antimony treatment, and most of them terminate fatally.

In brief, we consider there is sufficient evidence to demonstrate that antimony is by no means a satisfactory specific for kala-azar in this country, although it is fair to state that up to the present time, it has been the only drug of any value.

We agree with Sir Leonard Rogers that the problem of treatment in a poor country—and the Sudan is a poorer country than India—is still far from being satisfactorily solved

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Jan. 1.

[1] Rogers, L., NATURE, 144, 1003 (1939)
[2] Archibald, R G, *Amer J Trop. Med*, 3, 307 (1923)

[Sir Leonard Rogers informs us that cases are also occasionally met with in India that are completely resistant to any form of antimony treatment.—EDITORS.]

Points from Foregoing Letters

C. STORMER submits a diagram summarizing the results of more than a thousand measurements of the height of mother of pearl clouds observed from Norway during 1926–34 The mean height varied from 23·2 km to 27·7 km., and the clouds moved southeast at a high velocity.

By means of two separated transmitters the oblique critical frequencies of the *F* region were measured by T L. Eckersley *et al.* for the two opposite directions of propagation These frequencies were found to be identical for the two directions, both for the ordinary and extraordinary waves, showing that so far as electron limitation is concerned the conditions for propagation in one direction are the same as in the opposite direction. This special case of reversibility suggests that the law of reciprocity may be more generally valid in the ionosphere, since the critical rays examined are particularly sensitive to the properties of the refracting medium.

The end-point energy of uranium-X_2 has been measured by D. Roaf in a magnetic spectrometer using a new coincidence counter. The end point is found to be 2·3 Mev. This is not in agreement with Wilson chamber measurements.

P. Ohlin has investigated the short wave-length limit of the X-ray spectrum to determine *h/e*. He finds that the observations are very sensitive to the pressure in the X-ray tube; this may account for the discrepancies in the values of *h/e* obtained by this and other methods.

The excitation functions for the reactions $^{14}N + {}^{1}H \rightarrow {}^{15}O + h\nu$ and $^{16}O + {}^{1}H \rightarrow {}^{17}F + h\nu$ have been measured by S. C. Curran and J. E. Strothers. The yields expressed in positrons per proton were found to be $1\cdot5 \times 10^{-11}$ and $8\cdot0 \times 10^{-13}$ at $0\cdot96 \times 10^{6}$ and $0\cdot95 \times 10^{6}$ volts respectively.

From a study of the flame and arc spectra of certain alkaline earth compounds, R. K Asundi and B. K. Vaidya report the possibility of rearranging the SrCl bands with a doublet separation of about 260 cm.$^{-1}$ instead of 600 cm^{-1}. They further point out that the bright continuous bands associated with the spectra of these salts are probably due to metal molecules of the van der Waals type.

H Dingle suggests that the statement recently made by K R. Popper, that 'atomic clocks' are equivalent to 'light clocks' for scientific measurements, exemplifies a tendency in modern physics to divorce theory from experience.

The classical definition of mathematical stability will not meet the requirements of the problems of statistical mechanics. A. Wintner derives a new definition by use of a suitable formulation of Birkhoff's ergodic theorem. It turns out that, in a precise sense of statistical averages, the stability condition is satisfied both for the case of systems of classical integrable type and for the opposite extreme case of complete ergodicity.

E R. and F. W. Sansome report the occurrence of a genetical type of sterility in *Pisum sativum* occasioned by a complete failure of chromosome pairing at meiosis in the mega- and micro-sporocytes.

M. A Lipton and C. A. Elvehjem show that the production of cocarboxylase and adenylic acid by the enzymatic phosphorylation of thiamin can be accelerated in the presence of phosphoglyceric acid. Synthesis is stimulated by the addition of cozymase and inhibited by iodoacetate. This is explained by the fact that glucose inhibits the synthesis of cocarboxylase in the presence of phosphoglyceric acid and adenylic acid.

B. A. Toms describes the formation of hydrated stearanilide which after drying contained almost 80 per cent of water.

RESEARCH ITEMS

Gypsy Luck in Serbia

THE function of luck among Serbian gypsies is formulated as follows by Alexander Petrović in his continuing study of their beliefs (*J. Gypsy Lore Soc.*, Ser. 3, 19, 1–2; 1940). As they have no personified god, *O Del* (heaven) gives, and *Kar* (lingam) creates, but it is *Baχ* (luck) which gives to man the ability to use what these give and create. Some gypsies believe that Good Luck is a pretty girl, a nymph living in the woods, while Bad Luck is an old man or a toothless old woman, but the Serbian gypsies understand *Baχ* rather as some property of a man, animal or object. He who possesses such a capacity brings luck into the home, and this means health to the household and progress and success in every venture. In a household the wife's luck is the most important, and if a man is unsuccessful in business it may be the fault of his wife, and he may change the luck by being temporarily unfaithful to her. Luck may attach to the bag which a woman carries on her begging expeditions. One woman had had fourteen bags of which only the first was lucky. She always kept a scrap of rag from this one and carried it about with her. Luck may also reside in a whip or an article of clothing. If things or people are not luck bringers they may obtain this power by blessings, as when a wife throws water over her husband as he starts on a journey, saying, "Good luck to thee on thy way", or when a smith begins to use a new hammer and his neighbours say, "May thy hammer be lucky." In the same way certain persons, animals, things may bring bad luck (*Bibaχ*). If a child is unlucky it must be avoided. It must not pour water on you in the morning or talk to you early in the day. It should not approach the anvil, nor should tools be put in its hand, and if a boy it must not become a smith.

Maori Bowls

UNLIKE the Melanesians, the Polynesians never acquired the art of making pottery, but used as receptacles for a wide variety of purposes wood, supplemented to a certain extent by gourds and baskets of totara bark. The general style and perfection of finish of Polynesian and Melanesian wooden bowls vary considerably with different localities. The most perfect come from Hawaii. The Maori bowls show great variety of form, ranging from crudely hollowed out logs to beautifully finished examples, ornamented with carving. Some agree very closely in *motif* with Hawaiian bowls, while others have a distinctly Melanesian character. The collection of Maori bowls in the Auckland Museum, New Zealand, comprises more than forty examples. These have been described, with others not in the collection, but included for comparative purposes, by A. G. Stevenson, assistant ethnologist of the Museum (*Rec. Auckland Inst. Mus.*, 2, 4; 1939). The specimens are divided roughly into five classes mainly according to shape: long, trough-like bowls, short, broad and usually deep bowls, bowls of approximately equal length and breadth, the rim outline being between a square and a circle, bowls in which the bottom internally is flat, while externally they are hemispherical with or without a flat hemispherical base, and in the fifth class two bowls of distinctive type, one almost circular in outline on a small flat oval base, and the other in which the rim is almost circular, but thickens out to a point externally at each end. There are also a number of bowls of unusual form. The bowls, being primarily for use, are not ornamented as a rule, but there are notable exceptions, in which handles or spouts are carved to represent conventionalized human faces. Most of the bowls were of totara wood; but immersion in swamps over a prolonged period often makes exact identification of the wood impossible.

East Indian Gastropods

DRS. Adam and Leloup, in "Résultats scientifiques du Voyage aux Indes Orientales néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique" (Mém. du Musée d'hist. nat. de Belg., Bruxelles, 2, Fasc. 20; 1939), have concluded their study of the gastropods. The present volume deals with pulmonates, scaphopods and bivalves. There are five text figures, seven plates of shells and a map showing localities. The résumé of all the molluscs found, with localities, will be useful to collectors. Altogether nearly six hundred species are listed, but of these only a small number, comprising one amphineuran, one opisthobranch and seven pulmonates are new. This volume contains the last twelve families of pulmonates and one new species, *Ptychodon misoolensis*, which is not described, as an account of it appears elsewhere. The work is systematic and deals with shells and radulæ.

Fossils from the Belgian Ordovician

IN "L'Ordovicien de Sart-Bernard" (Mém. 86, Mus. Roy. d'hist. nat. de Belg., Bruxelles, 1939) E. Maillieux describes the fossils extracted from the Arenigian and Llandeilian strata of Sart-Bernard. There are three plates. From the Arenigian, graptolites, Lingula, trilobites and the Nebalian Lamprocaris are described, and resemble those of other Belgian rocks of the same age. From the Llandeilian one brachiopod, Pionodema, gastropods, lamellibranchs and trilobites are listed. As a whole the species are those peculiar to the Ordovician of Bohemia, except for *Conularia rugulosa*, which occurs also in Normandy, and the two species *Liospira æqualis* and Tentaculites n.sp. which have not been found in Bohemia. The first is a Scottish species. The two Belgian specimens of the second were unfortunately imperfect, so that no specific name is given to them.

Leaf-Growth as a Systematic Feature in Ammocharis

Milne-Redhead and Schweickerdt (*J. Linn. Soc.*, 52; 1939) have re-investigated the systematic position of the genus Ammocharis and related genera, especially Crinum. Whilst some species of

Crinum are readily distinguished by spiral leaf arrangement, others have distichous leaf arrangement as in Ammocharis, but the leaves are always sheathing at the base and are never biflabellately arranged. A peculiar feature of the leaves of Ammocharis, earlier described by Herbert, is that the leaves die down to the bulb but the same leaves resume growth and form new blades the next one or more seasons. The occurrence of this manner of leaf growth in *Crinum Tinneanum*, *C. heterostylum* and *C angolense*, and probably in *C. Baumii*, associated with biflabellate leaf arrangement, indicates that these species should be transferred to Ammocharis. The same peculiar feature of growth has been observed in some species of Crinum (subgenus Stenaster), but in these cases the spiral leaf arrangement, sheathing leaf bases and flower characters distinguish them readily from Ammocharis.

Graft Blight of Lilac

An interesting case of delayed incompatibility between stock and scion of a graft union is described by C H. Cadman in the *Gardeners' Chronicle* of January 13. Lilac buds upon privet stocks make good growth in the first season, but the foliage becomes rolled and mottled with yellow in the second year of joint growth. Leaves fall from the plant prematurely in subsequent seasons, and the ultimate result is a misshapen bush with thin, spindly shoots. The paper also reviews work by Chester, of the Arnold Arboretum, which shows that the trouble is non-pathogenic, and due solely to the incompatibility between stock and scion of the graft union Use of common *Syringa vulgaris* for a stock, or burying the Syringa-privet union so that the scion can ultimately form its own roots, are suggested as control measures. It is also possible to propagate the common varieties of lilac by cuttings or layers, though a longer time is necessary to produce plants of saleable size by these methods.

Origin of Lake Toba, North Sumatra

The history of Lake Toba provides one of the most convincing examples of a genetic connexion between tectonic and volcanic forces. In *De Ingenieur in Ned.-Indië* (4, No. 9, 126–140; Sept. 1939) van Bemmelen discusses the geological and volcanic evolution of the region and shows that the arching-up of a mountain range can, at least in part, result from the rise of magma or migma. The Toba cauldron is situated on the crest of a tumour-like culmination of the Barisan mountain range; it has an area of about 2,000 km.^{2} and a volume of 1,000–2,000 km.^{3}. On the top of the 'tumour' fissure eruptions occurred during the late Pleistocene, with a main paroxysmal phase of acid tuffs, followed by domes and outflows of acid lavas. The tuffs covered an area of 20,000–30,000 km.^{2} in Sumatra and extended to Malaya, where the thickness is still 5–20 ft. The volume of the tuffs is of the same order as that of the cauldron itself, which came into existence during or directly after the main outburst. The cauldron is therefore regarded as a 'super-caldera'. Van Bemmelen considers that a migmatitic batholith rose from the depths until it nearly reached the surface, arching up its cover and finally blowing out the gas-laden contents of its upper part through fissures in the roof. The paper is well illustrated and contains some interesting speculations on the origin of 'Pacific' magmas.

Heat Flow in the Earth's Crust

A. E. Benfield (*Proc. Roy. Soc.*, A, **173**, 428; 1939) has investigated the outward flow of heat in the earth at a number of points in England by investigating the thermal conductivities of rock specimens taken from boreholes and using a knowledge of the temperature distribution in the same holes. The thermal conductivities were found by placing a carefully prepared rock slice between the ends of a divided brass bar in which heat was flowing; the thermal contact at the interfaces was eliminated by comparing results on specimens of different thickness. The conductivities found range from 0·017 C.G.S. (rock salt) to 0·0014 (shale), and the heat flows calculated vary between $0 \cdot 7$ and $1 \cdot 5 \times 10^{-6}$ cal. per sec. per cm.^{2}. In the deep bores there was evidence of temperature disturbances consistent with the presence of an ice sheet on the surface up to 9,000 years ago This necessitates a correction which brings the mean equilibrium heat flow up to $1 \cdot 4 \times 10^{-6}$ cal per sec. per cm ^{2}. E. C. Bullard (*Proc. Roy. Soc.*, A, **173**, 450; 1939) has made similar conductivity measurements on rocks from deep bores on the Witwatersrand, and L. J. Krige (*ibid.*, 474) has made careful temperature measurements in these bores. The mean heat flow found is $1 \cdot 2 \times 10^{-6}$ cal. per sec per cm.^{2}. Both this value and Benfield's similar value in England are lower than those formerly estimated. It appears that there cannot be molten rock under England at a less depth than 20–30 km., while in the South African case, the layer of radioactive granite cannot be thicker than 12 km., and it is probably underlain by an intermediate layer as indicated by certain seismological observations.

Sun's Speed of Galactic Rotation

G. L. Camm has published an important paper (*Mon Not Roy. Astro. Soc.*, **100**, 1; November 1939) which leads to a much higher value for the velocity of the sun's galactic rotation than that generally accepted. The method adopted is to find the greatest difference between the angular speeds of rotation of the sun and of other objects in the galaxy, preferably those at great distances from the galactic axis, because their angular speeds would be small. Obviously a lower limit to the angular, and hence to the linear, speed of the sun can be determined in this way. Twenty-six globular clusters were divided into three groups, and it was found that the outer group, ranging from 12,000 to 38,000 parsecs from the galactic axis, appeared to be rotating as a rigid body—a view very difficult to sustain on dynamical grounds. Camm adopts the more reasonable hypothesis that the six clusters forming this group constitute a non-rotating frame, and their apparent motion is really caused by the opposite rotation of the sun. As an apparent angular velocity of -410 ± 50 km./sec. per 10,000 parsecs for the outer clusters was found, the speed of rotation of the sun is 410 ± 50 km./sec. If it is assumed that the outer clusters are rotating, the absolute linear speed of the sun will exceed 410 km./sec. The other groups ranged from 10,000 to 6,000 parsecs and from 4,000 parsecs to the galactic axis, and it was found that the clusters have a differential motion; quantitative agreement exists between this motion and that of other types of objects. This, with other established facts, helps to confirm Lindblad's theory of sub-systems within the galaxy, each with its own speed of rotation.

THE SUTTON HOO SHIP-BURIAL

THE outbreak of war followed so closely on the gift to the nation of the antiquities from the Saxon ship-burial at Sutton Hoo, Suffolk, by the owner, Mrs E. M. Pretty, which was announced on August 23, 1939, that there had been little opportunity for detailed examination of most of the objects, nor is any further occasion likely to arise while they are stored against damage. In these circumstances even the partial account to which the current issue of the official publication of the British Museum (Bloomsbury) (*Brit. Mus. Quart.*, 13. 4, 1939) is devoted affords information which will be welcome to archæologists and others, pending further study. A general account of the circumstances and character of the discovery and a description of the gold ornaments by Mr. T. D. Kendrick is followed by notes on the silver by Mr. Ernst Kitzinger, the coins by Mr. Derek Allen and other finds by Mr. T. D. Kendrick, who adds some reflections on the relation of the find to Anglo-Saxon archæology.

Mr. Kendrick points out that while some of the more important objects had been confided to the Museum as excavated, yet many of the notable objects, as, for example, the shield-boss and shield fittings, the helmet and sword have not yet been examined, and only hastily made record-photographs have been available for study.

It will be remembered that the barrow in which this ship was found was the largest of a group of twelve. The form of the ship, as traced, is more of the type of the fourth century type Nydam ship at Kiel than of the type of the Viking ships. The funeral deposit lay amidships under a collapsed wooden shelter in the form of a house with high-pitched roof, and constituted the richest series of grave goods ever found in England.

The richness and rarity of the finds is established by a brief description of their arrangement within the burial chamber measuring about 17 feet long by 8 feet wide. They were disposed H-wise, the horizontal bar corresponding with the keel of the boat and the uprights consisting of accumulations of offerings at the ends of the funeral chamber. At the west end was a standing bowl of bronze with drop handles and in this was a bronze hanging-bowl with elaborate enamelled ornaments, itself containing a wooden object with jewelled mounts that is probably a small stringed musical instrument, and other objects. By these bowls were heads of iron spears and angons, an ironbound wooden bucket, a huge lavishly decorated shield-boss and gilt shield-mounts, a gilt object believed to be a gaming board and among other objects an enormous ceremonial whetstone. Moving eastward, there was found the group of ornamental silver bowls and silver spoons, the remains of a magnificent helmet, the sword with a jewelled hilt of gold and the prodigious array of jewelled gold ornaments, sword harness and the outer trappings of a costly attire including the purse and its contents—gold coins and two ingots. Beyond these jewels were the remains of silver-mounted drinking horns, the great Anastasius and fluted silver dishes and a remarkable collection of miscellaneous objects.

Although the grave furniture was that of a man, there were neither vestiges of the buried body nor the ashes of cremation. Further, there was no single personal ornament of the deceased. Whatever may be the explanation, whether the barrow be cenotaph or grave, it is indubitably the monument of a pagan or semi-pagan royal personage possessed of huge wealth, who on the evidence of coins in his purse died before the first half of the seventh century. He may have been, it is suggested, Redwald, King of East Anglia, Bretwalda of England in 616 who died probably in 625.

The Gold Ornaments. In the fittings of the sword harness and outer apparel of their royal owner, all the pieces are contemporary and the work of one school, possibly of one man—one of the greatest of the many goldsmiths who worked in the cloisonné technique from the latter half of the fifth century onward. The most impressive single object is the massive gold buckle adorned in interlacing ornament and niello inlay, while next in importance comes the purse with its gold frame jewelled with garnets and mosaic glass and enriched with filigree bindings, its flanges, clasp and mountings ornamented in cloisonné and champlevé technique, while a number of minor ornaments are jewelled in garnets only.

The Silver. The outstanding find is the huge dish 27 inches in diameter, with a decoration of mixed ornamental designs. Byzantine control stamps, on which the monogram is of Anastasius, show it to be the work of a silversmith in the period A.D. 491–518. As a whole the silver objects are inferior as works of art to the gold. They belong to a decadent period of Mediterranean art, but within their own class they are important archæological documents. The large dish and the spoons throw new light on early Byzantine metal industry, and the smaller bowls appear to represent the art of certain semi-barbaric border regions of the Byzantine world which yet remain to be more clearly defined.

The Coins. The forty gold coins and two gold ingots found in the purse are the most inartistic objects in the whole burial, but nevertheless are of great importance, for it is on their evidence primarily that the dating of the burial must rest. They are of the denomination of tremissis or third of a solidus, and were all struck at Merovingian mints within or on the borders of France. Of none of the Sutton Hoo coins can it be said definitely that they were struck by a particular king, nor is any one of the moneyers known from historical sources. A rough dating is not before A.D. 600 nor likely to be before 640 or even 670.

Other Finds. Though intrinsically not the most valuable, the great ceremonial whetstone is archæologically the most amazing. Originally it was about 2 ft. long, square in section, the extremities adorned on each face with bearded masks, the stone ends in lobed bosses coloured red and enclosed in a bronze fitting with an empty and apparently useless cup-shaped terminal. Nothing like this stone exists anywhere else. Of equal importance archæologically is the bronze hanging bowl, with a mount from the

centre of the interior floor consisting of an oddity in the form of a substantial bronze fish, perched on a rod rising from a circular base, enamelled in the same style as the borders of the exterior mounts.

Sutton Hoo and Anglo-Saxon Archæology. The salient fact of the Sutton Hoo discovery is that, taken as a whole, it is a revelation of a new Pagan Saxon art and archæology in England It is both unfamiliar and startling. It is more than a pale reflection of the Jutish culture in Kent; it is the independent Golden Age in East Anglia confirming the historical fact of a dawning political ascendancy. Further, it will not be wise henceforth to debate the origins of our Christian art without paying respectful attention to this new evidence from Suffolk

MINERAL RESOURCES

BY PROF. R. N. RUDMOSE BROWN

IT has been said, with a considerable measure of truth, that one of the decisive factors in war is the accessibility of either side to essential minerals. These include in addition to iron, as the basis of steel, various less widely spread minerals such as the ores of nickel, manganese, titanium, tungsten, etc., and also the ores of copper, zinc, lead, aluminium, etc., and of course coal and above all mineral oil. The statistical summary for the years 1936–38 afforded by this issue of an annual publication* is specially valuable in giving, for most metals, the amount of the ores produced in each territory of the British Empire and also, in many cases, the metal content of the ore

The import and export for each country, including for some materials not only the crude materials but also the principal derivatives and semi-manufactured materials, are given. Unfortunately, for some important materials detailed figures are not available for all countries in 1938. To take first iron-ore, the world's production in 1938 was 165,000,000 long tons, of which 21,520,000 tons were from the British Empire and 28,700,000 tons from the United States. The other large producers were France with 33,000,000 tons, the U.S.S.R. with 27,000,000 tons and Sweden with 13,700,000 tons. Germany, Austria, Czechoslovakia and Poland between them produced about 16,000,000 tons Of the great producers only France, with 15,200,000 tons and Sweden with 12,500,000 tons, were great exporters, while of the importers Germany was far ahead of all other lands with 21,500,000 tons. The report does not indicate the sources of this huge import, but Sweden and France were the chief contributors. The United Kingdom imported only 5,100,000 tons of iron-ore: the rest was mainly home produced but a small quantity of pig iron was imported. In 1938 the United States led the world in steel production with 28,000,000 long tons, followed by Germany with 23,000,000 tons, the U.S.S.R. with 17,500,000 tons and the United Kingdom with 14,000,000 tons. With her imports of iron-ore and iron curtailed, the German steel figure must show a great reduction in current times

Nickel is an essential constituent of certain kinds of steel. Of the total world production in 1938 over 84 per cent came from Canada, another 10 per cent from French New Caledonia, a few tons from the U.S.S.R. and none from Central Europe. The two greatest importers of nickel were the United Kingdom and Germany, the latter probably leading, though different figures disagree These two countries between them took well over half the world's output. There is now no important source of nickel available to Germany. Chrome ore is more widely spread, but at least forty per cent of the world's output is in the Empire, with South Africa and Rhodesia producing most Other considerable outputs are in Turkey, Greece, Yugoslavia, Cuba, the Philippine Islands and New Caledonia Germany used to be the greatest importer of this ore in Europe, producing none herself. Manganese ore is widely found The Empire has about thirty per cent of the total production and though Germany has none, the U.S.S.R. has a great production and in recent years exported much.

Molybdenum ores are mainly in the United States, but Norway has large resources. Tin and cobalt ores are now almost inaccessible to Germany. One third of the output of lead-ore is from the British Empire, but some is still accessible to Germany from her own lands, the U.S.S.R. and Yugoslavia. Bauxite for aluminium can be obtained from Hungary and Yugoslavia, but supplies will be short.

Tungsten ores are not found abundantly in the Empire outside Burma, nor are there any considerable amounts in Europe outside Portugal. For several years Germany has been a large importer. Copper is another important metal of which the Empire produces about a third of the world's output, and the United States, Chile and the U.S.S.R much of the remainder. Germany, producing little, used to be a great importer and still has access to Yugoslav copper ore.

Lastly, the position in regard to mineral oil may be noted, without going into details of quality and by-products. In this mineral the Empire is poorly endowed In 1938 the Empire produced less than three per cent of the world's crude petroleum, the only lands producing a notable amount being Trinidad, the Bahrein Islands and Burma, and none of these produced one per cent of the world's total. The largest producers were the United States with 60 per cent, the U.S.S.R. and Venezuela, each with about 10 per cent of the world's total. Other considerable but much lower producers were Iran (3·8 per cent), Netherlands East Indies (2·7 per cent) and Rumania (2·4 per cent). Outside Rumania there was no noteworthy production in Central Europe: the Polish and Czechoslovak output were quite inconsiderable. The U.S.S.R. was a great exporter, by sea, of petroleum and allied products, but this trade she shared with all the large producers as well as Rumania. Thus even if the United Kingdom has ample sources of mineral oil within reach, it can scarcely be said that Germany is deprived of possible sources of import. There are, of course, problems of transport that may modify the position.

* The Mineral Industry of the British Empire and Foreign Countries Statistical Summary 1936–38 Imperial Institute. (H.M Stationery Office, 1939) 7s. 6d net.

FACSIMILE TRANSMISSION

AN instructive paper, by G. Herrick, describing the progress in the United States of facsimile transmission, that is, the transmission of the printed page, drawings, photographs, documents and original messages by radio or wire telegraphy, appears in the *Electrical Review* of January 19. Certain electrical problems, more commercial than technical, have yet to be solved, and further development makes it necessary to use the best type of paper for recording purposes Recently when President Roosevelt went to Canadian waters on a fishing trip, on board the U.S. Cruiser *Tuscaloosa*, he received a total of about 50,000 words of news on a facsimile receiver in his office-cabin, while the ship's officers received the same news on a duplicate receiver in the vessel's office.

The information transmitted was gathered by Trans-Radio News, set in type by the Koppel Printing Co in New York, and broadcast from Cartaret, N.J., by the Finch system of transmission over the regular 780 kc. used by the station WOR of the Mutual Broadcasting Co The transmissions were received in the afternoon in the *Tuscaloosa*, which reached a maximum distance of 650 miles from the transmitter As the ship returned and neared New York, the smaller transmitter at the Finch Telecommunications Laboratories in Broadway, New York, took over transmission. For the transmission, alternating current at 110 volts and 60 cycles was used to energize both the transmitter and receiver One of the difficulties to be overcome in the development of facsimile transmission is the fact that the power stations in different States often vary in frequency

At present three systems of facsimile transmission of printed material and pictures are being developed The R.C.A system is controlled by the Radio Corporation of America and uses what is called 'percussion' recording through varying electrical impulses, which record lines on any grade of paper through the medium of a carbon sheet. The drawback is that it operates at only about three feet an hour.

The system controlled by Finch Telecommunication Laboratories records on special paper that is basically black and coated with an 'eggshell' surface Across this an electric stylus travels, being regulated by impulses received at standard radio frequencies, or over a telegraph or telephone wire. The stylus draws a hundred lines to the inch and, by oxidizing the surface coating to a greater or lesser degree, records a variety of shades from grey to black.

The system of J V. L. Hogan, consulting engineer of New York, was used with interesting results at the Toronto Fair by the *Globe-Mail* of that city. This method also employs the stylus principle of recording. Instead of oxidizing a specially coated paper, a series of points that are in contact with specially sensitized paper in rolls delivers varying electrical impulses to the paper and develops the required type of picture as the paper unrolls in the receiver. This system is extremely clear and can record very minute details, such as a photograph of a lace tablecloth or type down to 6-point. All the three differing systems require the material to be transmitted to be placed on a revolving drum, so that it is scanned by a point of light with which is associated a photo-electric tube that reacts to the reflections of light from light and dark substances, varying the impulses sent out

In the United States, development of this kind of transmission has been delayed by the public and technical interest taken in television. To-day, with television making satisfactory progress, facsimile transmission is being developed rapidly. What the public want is low-cost synchronizers which are both efficient and do not slow down transmission. Some of the synchronizers in use necessitate low speed. The transmissions to the *Tuscaloosa*, for example, were received at three feet an hour

Photographs both by radio and wire are being sent across the Atlantic at the present time. As an indication of future possibilities, consider the dissemination of news from one city to another by transmitting entire printed pages with illustrations, which would be multiplied by photo-offset printing, and could be sold in the streets within two hours after being sent. This plan envisages the use of wired rather than wireless transmission, technicians engaged in facsimile development suggest that their experiments have indicated that wired facsimile may be less certain than wireless, except in certain sections

Unlike the television receiver, facsimile apparatus can be built at low cost because it is comparatively simple The cheapest television sets in the United States cost about £39, but it is believed that a standard facsimile receiver could be constructed to retail at £10

The Finch organization has recently brought out mobile facsimile transmitters and receivers. Several police motor-cars in Bergen County, New Jersey, just across the Hudson River from New York City, have been equipped with facsimile two-way units that can send and receive alternately A New York newspaper is experimenting with a motor-car into which is built transmitter, receiver and a dark room It has a tiny writing space and typewriter for the news man.

The Finch Company has developed a method of utilizing any telephone; strangely enough, the method has been approved by the telephone company, which has rigorous rules against tampering with its lines or equipment The unit is an inductive coupling and cable With one end of the cable attached to the transmitting and receiving unit in the motor-car or special truck, the other end of the cable is carried from the kerb into the nearest public or other telephone The user then calls the telephone operator and says, "Do not interrupt, this wire is being used for a facsimile transmission". The use is thereafter charged at the ordinary telephone rate. During the transmission of news and pictures in this way, it is not necessary to use the telephone, as the office of reception can transmit messages of instruction back to the truck transmitter by writing and having them scanned on its own transmitting drum.

Similar testing of facsimile is being done by the U.S Army, and the Navy is understood to be increasingly interested in possible use of facsimile for intercommunication between naval ships and messages to and from bases.

PROPAGATION OF RADIO WAVES ALONG THE EARTH

THE mode of propagation of electric waves along the surface of the earth has been investigated theoretically since the earliest days of practical radio communication, and a paper by A Sommerfeld published in 1909 has since become a classical treatise on this subject After a period during which attention was mainly confined to the study of wave propagation through the ionosphere, the inception of broadcasting and the practical application of ultra-short waves have caused renewed interest in the problem of propagation along the ground.

Two papers having a direct bearing on this subject have recently been issued by the Institution of Electrical Engineers, and would, in normal circumstances, have been read before a meeting of the Wireless Section on January 3. The first, by Dr. J S McPetrie and Miss A. C. Stickland, is entitled "Reflection Curves and Propagation Characteristics of Radio Waves along the Earth's Surface"; it deals with the evaluation of the reflection coefficient of the earth's surface, and then with the application of this knowledge to the study of propagation along the earth. A collection of curves given in this and an earlier paper enables the reflection coefficient for radio waves of any frequency and state of polarization to be determined for any angle of incidence and for various values of electrical constants of the earth.

It is pointed out that the ray theory, on which the reflection from a surface is assumed to be equal to the radiation from an image of the transmitting aerial, is not applicable at grazing incidence unless the heights of the transmitting and receiving aerials are comparable with the wave-length. From an analysis given by K. A Norton, however, it is deduced that, when the ray theory does not apply, the field at the receiver is equal in most practical cases to the vector addition of two fields; the first is the field given by the simple ray theory while the second, which is independent of the heights of transmitter and receiver, corresponds to the surface wave first postulated by Sommerfeld for vertically polarized waves. The ratio of the magnitudes of the surface wave to the image fields is much less for horizontally than for vertically polarized waves, so that the ray theory is applicable over a wider range of angle of incidence in the former case. As the surface wave is independent of height, this results in the well-known experimental fact that the vertical field from a low transmitting aerial increases in magnitude with height at a much smaller rate than the horizontally polarized field

The second paper, by Dr J S McPetrie and Mr. J A Saxton, describes the results of an experimental investigation of the characteristics within optical range of the propagation overland of radio waves of length 2 and 3 metres Measurements of the field strength received at various distances from the transmitter confirm the theoretical deduction that, provided the heights of both transmitting and receiving aerials are comparable with the wave-length, the propagation at grazing incidence is the same for both horizontally and vertically polarized waves. In either case, the field strength is proportional to the product of the heights of the transmitter and receiver, and inversely proportional to the square of the distance between them. It was found that, within the optical range of the transmitter, the propagation characteristics corresponded to the condition of a plane rather than a spherical earth, although the varying contours of the path of transmission produced a marked effect on the received field strength. Over a town area, the ratio of the measured to the theoretical field strength was less on a wave-length of 2 metres than on 3 metres.

CAVE FAUNAS

THE specialized cave faunas of the world have been investigated extensively during the last fifty years, and to this prolific literature is now added the results of exploration in the numerous caves of Belgium. Dr. R. Leruth contributes "La Biologie du Domaine Souterrain et la Faune Cavernicole de la Belgique" (Mém 87 Musée Royal d'histoire naturelle de Belgique, 1939), and in the same series, Mém 88 by Dr C. R. Boettger is entitled "Die Subterrane Molluskenfauna Belgiens".

The vast grottoes near Han-sur-Lesse furnished much of the material, although forty-eight subterranean regions were explored The collections were submitted to specialists for identification. A general section deals with the ecological and geological conditions affecting the Belgian cave faunas, and Dr Leruth classifies the inhabitants as permanent, temporary or accidental cave-dwellers. The first are completely adapted to their mode of life, the second can live either within or without underground areas, and the third are ill-adapted to cave life and are incapable of breeding there. There are also parasites and scavengers. The terrestrial fauna is poor in species, but the aquatic fauna is relatively rich. Of approximately six hundred species, one genus and sixteen species are new. Bats, mice and rats are the chief mammals, while badgers and foxes penetrate into the smaller caverns. Neither fishes nor amphibia are recorded Among invertebrates, flatworms, roundworms and ringed worms, arthropods of all kinds and in large numbers, and some molluscs were found.

Dr. Boettger describes the collections of Dr. Leruth and Prof. Séverin. Pisidium is the only lamellibranch genus. Among prosobranchs there are several members of the Hydrobiidæ. Pulmonates are common, especially as the faunas of crevices and underground water channels are included. A blind land snail, *Caecilioides acicula*, and the freshwater prosobranch, *Avenionia bourguignati*, are true cave forms, the latter being a French species recorded for the first time in Belgium.

MINE RESCUE TELEPHONE

MR. R. C. WOODS, of the Ericsson Telephones, Ltd., London, communicates a description of a mine rescue telephone to the *Ericsson Review* of 1939 (No. 2). The Coal Mines Regulations require owners of mines, to which the regulations apply, to make definite provision for rescue work in mines after an explosion, fire or other accident. Telephone communication between the rescue brigade and its base is of great importance. Ericsson Telephones, Ltd., in collaboration with the Mines Department Testing Station, have constructed a mine rescue telephone which was officially tested last year, after which the production was immediately undertaken.

When a rescue corps is called to a mine, a base is immediately established in fresh air but as near as possible to the zone where the air is so foul as to be unbreathable. As the team of from eight to five men will be wearing breathing apparatus, speech is impracticable and communication has to be established by other means. Uniform codes of signals are prescribed, one for use between members of a brigade, for which each man carries a bulb hooter, and one for electric signalling While the existing mine telephone system may provide for the telephone communication between the rescue corps and the base, it cannot be depended on and it would rarely prove convenient, speech not being practicable owing to the breathing apparatus, both of which are vital factors in such an apparatus, which only comes into use in severe conditions.

The mine rescue apparatus constructed by Ericsson's consists of two units, a base station and an advance station, connected continuously by a light but tough cable. In the constructional features of the design, particular attention has been paid to strength and low weight.

Signals in both directions are effected by a buzzer, using a special code. The note is distinct and penetrating, the high frequency avoiding any chance of confusion with other noises. In addition, the base party can speak to the advance party, both speech and signals being received on the loud-speaker at the advance station unit. After much consideration it was decided to limit to key signals only communications from the advanced party. If both-way speech were provided, the additional equipment would appreciably reduce the mobility of the advance party.

The base station unit is about 24 cm square with a depth of 16 cm. On the front of it there is fitted a sensitive transmitter, a small loud-speaking receiver and a high-frequency buzzer. When the keys are in their normal position, the loud-speaking receiver is connected directly to the trailing cable and hence to the advance station unit. Any signal sent out by the advance party is thus immediately reproduced by this receiver. The batteries are of the ordinary cycle lamp type so that replacements are readily obtainable. Battery voltages are 6 and 3 volts respectively for the use of the base and advance party units.

Safe operation in dangerous atmospheres is a feature of this system. If during rescue operations it is desired to extend beyond the first cable length, a further advance party instrument can be connected by a simple plug and the circuit transferred from the first to the second unit.

SEVENTY YEARS AGO

NATURE, vol. 1, February 10, 1870

The Royal Commission on Science

"THE Council of the British Association for the Advancement of Science was received on Friday last by Earl de Grey, Lord President of the Council, as a deputation to urge on the Government the issuing of a Royal Commission to inquire into the state of Science in England

"The main points for a Royal Commission to throw light upon are these. First, is it right that science should be aided by the State ? Secondly, is the aid now given exactly what is needed—neither too much nor too little ? Thirdly, the degree and direction in which science should become a State business having been settled, what will be the best organisation for the purpose ? Not one of these points has ever yet been thoroughly considered in England"

Microscopical Investigation of Meteorites

PROF. N. S. MASKELYNE, of the British Museum, provided a full abstract of his recent paper on this subject presented to the Royal Society. Transparent sections of small fragments cut from meteorites were studied under the microscope They showed that "a meteorite has passed through changes and that it has had a history of which some of the facts are written in legible characters on the meteorite itself and, one finds, that it is not difficult roughly to classify meteorites according to the variety of their structure One also recognises constantly recurring minerals ; but the method affords no means of determining what these are" The chief use of the microscope was as a means of sorting out the various minerals from "the bruised débris of a part of the meteorite", investigating each by the goniometer and by analysis, "and finally returning to the section to identify the actual minerals present".

The Work of the Sea

IN an article by C. W Whitaker, M. Quenault is quoted as concluding, with regard to the depression of the land · "One gathers from all these evidences, that the movement, since the eighth century, has been about two metres a century. If it continues at the same rate for ten centuries more, the peninsula of Cotentin will be an island and all the ports of La Manche will be destroyed. Some centuries later and Paris will be a seaport, waiting only to be submerged in a score of centuries. Thus in a period, less than half as long as that during which the pyramids of Egypt have braved the ravages of time, Paris itself—if it is not burned down during one of the revolutions of its inhabitants, as amiable and *spiritual* as they are inconsistent—Paris will probably be engulphed in the Atlantic, a master before whom the intractable Parisian must haul down his flag. Let him take warning !"

WITH reference to the "situation" at the Paris Observatory [see NATURE of February 3, 1939, p. 198], the action "of the French Government has been of the promptest and M. Le Verrier is no longer Director. This step indicates very clearly—too clearly we fear—the strength of the case put before the Minister of Public Instruction. . . . The document was signed by Villarceau, Marié-Davy, Wolf and Loewy. . . .

It is to be sincerely hoped that M. Le Verrier may be able yet to do service to astronomy, in some other capacity, some position where his great talents alone will be called into play."

"A NEW office has been constituted under the Public Works Department and Mr Douglas Galton, C.B., F.R.S., has been appointed to it with the title of Director of Works and Buildings We may congratulate ourselves that our public building will be looked after by one so eminently qualified by his high scientific attainments and great experience in such matters."

M Vérard de Sainte-Anne read a memoir before the Paris Academy of Sciences on a project for establishing communication between France and England. The author proposed the establishment of a railway bridge, either open or tubular, across the Straits of Dover

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned

COMMISSIONED ORDNANCE MECHANICAL ENGINEERS in the Indian Army Ordnance Corps—The Secretary, Military Department, India Office, Whitehall, S W 1 (quoting 'O.M E Recruitment') (February 14)

DIRECTOR for the British Institute in Milan—The British Council, 3 Hanover Street, W 1 (quoting 'Milan') (February 15)

RESEARCH OFFICER for Bacteriological work—The Secretary, Agricultural Research Council, 6a Dean's Yard, Westminster, S W 1 (March 31)

RADIO ENGINEERS by the Royal Army Ordnance Corps—The Under-Secretary of State (A.G 9), War Office, Hobart House, Grosvenor Place, S.W 1

MECHANICAL AND AUTOMOBILE ENGINEERS by the Royal Army Ordnance Corps—The Under-Secretary of State (A G 9), War Office, Hobart House, Grosvenor Place, S W 1

ENGINEER AND SHIP SURVEYOR for the Department of the Surveyor-General of Ships, Straits Settlements—The Crown Agents for the Colonies, 4 Millbank, S W 1 (quoting M/9066)

TEMPORARY FORECASTERS, Grade II (Male), in the Meteorological Office—The Under Secretary of State, S.2 B (Met), Department Q A , Air Ministry Adastral House, Kingsway, W.C 2

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research Report of the Road Research Board with the Report of the Director of Road Research, for the Year ended 31st March 1939 Pp viii + 172 + 15 plates (London H M Stationery Office) 3s 6d net [221

Department of Scientific and Industrial Research Water Pollution Research Summary of Current Literature Vol 13, No 1, January 1940, Abstracts Nos 1-137 Pp iv + 36 (London H.M Stationery Office.) 2s net [241

University of Liverpool Social Science Department, Statistics Division The Economic Status of Coloured Families in the Port of Liverpool Pp. 23 (Liverpool University Press of Liverpool, Ltd) 1s net [251

Medical Research Council Special Report Series, No 230 . Medical Uses of Radium Summary of Reports from Research Centres for 1938 Pp 49 (London H M Stationery Office.) 1s. net [291

Ministry of Health Memorandum on the Production of Artificial Immunity against Diphtheria (Memo. 170 Med) Revised edition Pp 8 (London H M Stationery Office) 1d net [291

Other Countries

Bernice P. Bishop Museum. Bulletin 142 Marquesan Insects, 3 (Pacific Entomological Survey, Publication 8) Pp. v + 220 Bulletin 159 : Review of the Fauna of the Marquesas Islands and Discussion of its Origin By A. M Adamson. (Pacific Entomological Survey, Publication 10) Pp ii + 94 Bulletin No 163 : Archaeology of Mangareva and neighboring Atolls By Kenneth P. Emory Pp 76 + 6 plates Bulletin 164 Report of the Director for 1938 By Peter H Buck (Te Rangi Hiroa). Pp. 32. Index to Pacific Entomological Survey Publications (Bulletins 98, 113, 114, 142.) Pp 36 (Honolulu : Bernice P. Bishop Museum.) [231

Bernice P Bishop Museum. Occasional Papers Vol. 14, No. 14 : Fouling Organisms in Hawaii By Charles Howard Edmondson and William Marcus Ingram Pp 251-300 (9 plates). Vol. 14, No. 15 Revision of the Fijian *Ottistirini* (Coleoptera, Curculionidae). By Elwood C. Zimmerman Pp 301-312. Vol 14, No. 16 . A New Species of *Byttneria* from Mangareva. By E. D Merrill Pp. 313-316 Vol 14, No 17 The Genus *Phanerostethus* in Fiji (Coleoptera, *Curculionidae*) *By Elwood C. Zimmerman Pp* 317-322 Vol. 14, No 18 *Cypraeidae* from Makatea Island, Tuamotu Archipelago By William M Ingram Pp 323-326 Vol. 14, No. 19 : Endemic Hawaiian Cowries By William M Ingram Pp 327-334 Vol 14, No 20 Preliminary Revision of the Fijian *Baridinae* (Coleoptera, Curculionidae). By Elwood C. Zimmerman Pp. 335-348 Vol. 14, No. 21 *Santalum ellipticum*, a Restatement of Gaudichaud's Species. By Frank E Egler Pp 349-358 Vol 15, No 1 . New Hawaiian Species of *Clermontia*, including a Revision of the *Clermontia grandiflora* Group By Harold St John (Hawaiian Plant Studies, 6) Pp 20 (6 plates) Vol 15, No 2 New Hawaiian *Lobeliaceae* By Harold St John (Hawaiian Plant Studies, 7) Pp 21-36 (7 plates) Vol 15, No 3 Notes on Polynesian Grasses By F R Fosberg Pp. 37-48. Vol 15, No 4 Taxonomy of the Hawaiian Genus *Broussaisia* (Saxifragaceae) By F. Raymond Fosberg. Pp 49-60 Vol. 15, No 5 Bees from the Caroline and Palau Islands and Yap (Hymenoptera, Apoidea) By T D A Cockerell. Pp 61-66 Vol. 15, No. 6 Reports on Fossil Mollusca of Molokai and Maui By Jens Mathias Ostergaard Pp 67-78 Vol 15, No 7 New or Interesting Ferns from Micronesia, Fiji and Samoa By E B Copeland Pp 79-92 Vol 15, No 8 Supplement to the Manual of Hawaiian Mosses By Edwin B Bastram Pp 93-108 Vol 15, No 9 The Genus *Ficus* in the Samoan Islands By V S Summerhayes Pp 109-118 Vol 15, No 10 *Diospyros ferrea* (Ebenaceae) in Hawaii By F. R Fosberg Pp. 119-132 Vol 15, No 11 Studies of the Pacific Bees in the Collection *of Bishop Museum (Hymenoptera, Apoidea)* By T. D. A. Cockerell. Pp 133-140 Vol 15, No 12 *Thysanoptera* collected by the Mangarevan Expedition By Dudley Moulton Pp 141-148 Vol 15, No 13 The Canoe Making Profession of Ancient Times. Translated by Mary Kawena Pukui, Edited and annotated by Kenneth P Emory Pp. 149-160 Vol 15, No 14 A New Species of *Zoraptera* from Fiji By Ashley Buell Gurney Pp 161-166 (Honolulu Bernice P Bishop Museum) [231

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Proceedings of the California Academy of Sciences, Fourth Series Vol 23, *No* 25 Notes on *some Forms of Oreohelix strigosa* By G. Dallas Hanna and Allyn G Smith. Pp 381-392 + plates 33-36. Vol 23, No 26 Notes on a Collection of Reptiles and Amphibians from Guatemala, 1 Snakes. By Joseph R Slevin Pp. 393-414 + plates 37-38 Vol 23, No 27 A New Genus and Species of Marine Ostracods from South Georgia By Tage Skogsberg Pp 415-426 Vol. 23, No 28 The *Bees of the* Southern California Islands. By Prof T. D. A Cockerell Pp 427-436 (San Francisco, Calif : California Academy of Sciences) [251

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U S Department of the Interior Office of Education. Bulletin, 1939, No. 2 Accredited Secondary Schools in the United States By Margaret J S Carr. Pp v + 180 (Washington, D C. Government Printing Office) 20 cents [251

Om Uppfinningen av den Akromatiska och Aplanatiska Linsen med Särskild Hänsyn till Samuel Klingenstiernas Insats. Av N. V. E. Nordenmark och Johan Nordström (Särtryck ur Lychnos 1938 och 1939) With an English Summary Pp. 52 + 313-384 (Uppsala Almqvist and Wiksells Boktryckeri A.-B.) [291

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Field Museum of Natural History Botanical Series, Vol 20, No. 2 Francis Wolle's Filamentous Myxophyceae By Francis Drouet (Publication 460.) Pp. 15-64 40 cents Botanical Series, Vol. 20, No 3 The Planktonic Freshwater Species of Microcystis. By Francis Drouet and William A. Daily. (Publication 461.) Pp. 65-84 15 cents. (Chicago Field Museum of Natural History.) [291

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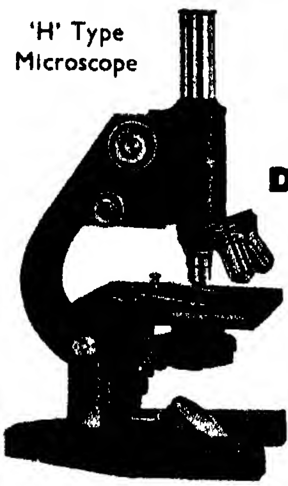

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CIVILIZATION AND THE RIGHTS OF MAN

MUCH has been said and written recently on the causes of the present conflict between Germany and the Allies and the conditions of peace, but most of it has been from the point of view of national expediency and little from that of the history of civilization or the future of mankind In his two latest books—"The Fate of *Homo sapiens*" and "The New World Order"—Mr H G Wells takes an eagle-eyed view of the world of man, as he did in his "Outline of History", and brings his critical mind to bear upon what he sees. With a few other students of history he realizes that the scientific method of inquiry can be profitably applied to political and social problems, as it is to other aspects of biological development In the struggle for existence of all forms of life, many factors are involved, and the aim of scientific investigation is to discover their nature and influence. The history of civilization shows that the chief causes of war have been migratory movements—represented in modern times by access to natural resources and the claim for *Lebensraum*—aggressive nationalism, racial lust and religious hatred

In the natural instincts which have led to struggles between groups of peoples, mankind is the same as it was at the beginning of civilization six thousand years ago. There has been great increase of knowledge but not a corresponding increase of wisdom in the use of it. If an individual or a nation has the will to assert a claim by force, he can acquire in an open market whatever power he is prepared to pay for and use. In a civilized community, citizens protect themselves from such dangerous disturbers of the peace by means of a police force; but there is no similar force to prevent breaches of the world's order by truculent nations, and no international court whose judgments upon disputes are accepted as final

If the civilized world is to survive, the hour has come when measures will have to be devised to control the "gangster" element in human nature, whenever or wherever it manifests itself Authority to exercise such power will come only when nations believe that it is in their own interest to combine for the common good of the whole community of mankind. How this end can be attained, and the changes which will have to be made in social and political structures in order to achieve it, signify reconstruction of existing systems in a manner which may rightly be described as revolutionary. The aim of such a revolution is not, however, to readjust class relationships, but to create a world commonwealth of free peoples conscious of their responsibilities one to another, and accepting the principle of "Live and let live" rather than that of "Lie and let lie", which is often an excuse for political diplomacy

This is the type of revolution which Mr Wells foresees, if civilization is to be saved from self-destruction. He urges that "It is the system of nationalistic individualism and unco-ordinated enterprise that is the world's disease"; and that the old foundations of the system have proved unable to support the ponderous structure which has been built upon them. To strengthen one part by political balance of power or alliances makes other parts of the structure relatively weaker, with the result that the stability of the whole suffers. Mr. Wells has, therefore, no sympathy with the movement for the federation of a number of European States, unless it is deliberately made the basis of a system designed ultimately to comprehend all the peoples of the world.

There is nothing new in the spirit of this intention. The philosophy of the Stoics included the principle of the brotherhood of man and the merging of all nationalities in a cosmopolitan citizenship. Christianity adopted the same ethical doctrine, and still pursues it; yet neither in economic nor in political spheres are national policies or actions determined by it. After nearly two thousand years of teaching peace on earth, good will towards men, this principle of all systems of ethics does not enter into the field of practical politics of Christian nations any more than it does in other communities It may be that a world commonwealth of nations is just as far off as a world fellowship of religious faiths, but that does not make the ideal less worthy of effort to attain it The mines and torpedoes which lie in the track of civilization at the present time make it more necessary now than ever it was for navigators to be guided by a single light, instead of each ship of State, or convoy, following a course which must cross the tracks of others and lead to collisions.

Though, in the past, war has played a part in the formation of certain groups, it represents only one phase in the development of civilization. It is true that civilization has developed through individual peoples, as, historically speaking, mankind has been organized on that basis, but we, as heirs of the ages—to use a trite but expressive phrase in this connexion—are not interested in the survival of these peoples, except in so far as they have contributed to the general advancement of the human race The trend of cultural achievement in the advancement of mankind has been to operate through larger and larger unities—tribe, people, nation, confederacy—eliminating war and the struggle for existence as physical facts, and relying more and more on the struggle for existence between ideas

It is towards such a world commonwealth, in which each nation can be free to follow its own course of cultural development, that Mr. Wells would direct civilized thought It may be held that this conception represents merely a reversion to primitive social structures; but the difference is in the extent of outlook Whereas, in the primitive form, the sense of responsibility embraces the members of the same blood-kin only, or those of the local group within which the members are more or less intimately acquainted, in a modern society it may reach out to embrace all members of a great nation, and possibly, when conflicting creeds and ideals agree to sink their differences, it may extend to all men of good will, to whom the dignity of man as an individual entity transcends racial and political boundaries.

When, if ever, this comes to pass, it will be possible to gauge how far mankind has advanced along the road of ethical as well as material progress To many, the way seems long to go. The urge of nationalism and its ideals, combined with belief in might as the sole arbiter of right, has diverted the thoughts of peoples away from the main stream of human progress into narrower channels in which rocks and rapids threaten at every turn to shipwreck all that is best in civilization

In what is conceived to be the highest type of civilization to-day, certain ethical and humane sentiments, such as those of truth and righteousness, justice and mercy, and sympathy with the weak and suffering, are possessed and practised by a greater number of the community than ever before. These high attributes of human nature have survived the ages of violence, cruelty and rapine which have disgraced European history, and by which the recrudescence in our own times will be remembered In spite of these degrading influences, there has been an increase in the true, the humane and the just, and the standards of conduct towards others have become ethically higher, until now no people or nation which reverts to such methods can claim to be in the van of modern civilization. In so far as the present conflict is one of ideals, it may fairly be said that those of the Allies represent a far higher ethical standard than exists at present in Germany.

Freedom of thought and speech, belief and investigation, subject only to the recognition of the same liberty on the part of others, is threatened by the new tyrannies which, through their aggressive militarism and economic nationalism run mad, seek to reduce the citizen to a soulless unit and a condition of moral and intellectual servitude. The existence of economic antagonism and military rivalries among nations is as grave a danger to scientific thought and investigation, upon which so many material achievements are based, as it is to the general progress of civilized life Science must, therefore, stand for high human values, as against slavery of the spirit of man, if civilization is to be preserved from the dangers which now threaten it.

There are certain fundamental human rights the recognition of which would do much to promote a sense of common interest among the

peoples of the world. Mr. Wells gives the first draft of such a Declaration of the Rights of Man in his "New World Order"; and the *Daily Herald* is submitting it to free and wide discussion with the view of constructing a new charter to represent man's just claims in a modern society. The intention is eventually to produce a Declaration which will represent world-wide opinion, and will crystallize the thoughts of men and women of all ranks and of all races who believe in the essential greatness of mankind It is hoped that such a Declaration at the present epoch may have valuable consequences in shaping the structure of human society to the benefit of mankind

Representatives of science are invited, with those interested in other fields of progressive life, to assist in making the final form of the Declaration a worthy and enduring statement of human needs. The time has come for the assertion of the rights of scientific and other intellectual workers in modern life, in view of the conditions of cruelty and suppression to which their work is now subject in some countries Such a Declaration would insist that creative ideas are the essence of progressive thought and achievement in science, as in art and literature; and that to make them subversive to the principles of any social doctrine or political system is to restrain the expansion of the human mind and its means of expression. Research can be organized and team-work be profitably applied to solve particular problems, but the true heart of science is in original independent thought; and this can neither be created nor regimented by political authority

It has been suggested that a charter should be framed embodying these and other principles of liberty of thought, and freedom from the frustration by authority, which have long been assumed to be characteristic of scientific activity. Little encouragement has been given to this idea in scientific circles, otherwise the Society for the Protection of Science and Learning, or the British Association's Division for Social and International Relations of Science, would no doubt have produced such a charter The world of science is international in its constitution and aims, and citizenship can be claimed in it by men and women of any race or nationality who will respect the principles implied in the pursuit of scientific truth and endeavour to contribute to the advancement of natural knowledge by following them. The Declaration of the Rights of Man which should emerge from the discussion organized by the *Daily Herald* will no doubt include these principles, among others which may be justly claimed by all the citizens of the modern world

PROPERTIES OF MATTER IN BULK

Statistical Thermodynamics
A Version of Statistical Mechanics for Students of Physics and Chemistry By Prof. R H. Fowler and Dr. E. A Guggenheim. Pp. x + 693 (Cambridge: At the University Press, 1939) 40*s* net

PROF R. H FOWLER, with the able assistance of Dr E A. Guggenheim, has produced a book which will serve in many respects as a third edition of his "Statistical Mechanics", but which does not supersede the former work entirely. The present book is written with rather a different aim in view The first edition of "Statistical Mechanics" gives the impression that the author's interest was centred primarily on a new and elegant mathematical technique, the "method of steepest descents", which could be applied with profit to a very large number of physical problems The second edition represents a transition stage, with more emphasis on the physical problems and less on the principles of statistical mechanics. In the present work the shift of emphasis is complete. It is a book, admittedly written from a mathematical point of view, about the properties of matter in bulk. Theorems of statistical mechanics and of thermodynamics are both used, as may be convenient, to discuss the problems under consideration; once the laws of thermodynamics and their connexion with statistical quantities have been derived, full use is made of them whenever it seems advantageous. It was this fact which suggested the title "Statistical Thermodynamics" given to the book.

In accordance with the utilitarian nature of the book, no discussion is given of the truth of the fundamental axioms of statistical mechanics; these are merely stated, and the reader is referred to recent books on the foundations, such as that by Tolman Since, moreover, it is intended primarily for students of physical chemistry (or, may we say, chemical physics), the chapters which appeared in the old book about astrophysical and atmospheric problems are omitted.

After the general methods of statistical mechanics have been discussed, the book opens with a discussion of the specific heats of perfect gases, which has been brought thoroughly up to date. Chapters on crystals and on chemical equilibria follow, and then chapters on imperfect gases, liquids, and the theory of condensation Solutions of electrolytes, adsorbed surface layers, elementary electron theory of metals, lattice imperfections and order-disorder in crystals, and dielectric and magnetic properties of matter in bulk are other subjects treated There is also a chapter on chemical kinetics, which, although not a subject which can be included under the heading of the properties of matter in equilibrium, is nevertheless a field in which the methods of statistical mechanics have been applied extensively to calculate the number of molecules in the activated state.

A study of the book and in particular a comparison with Prof. Fowler's earlier treatise is interesting especially in reminding the reader of the subjects in this field which have received the most attention from theoretical physicists during the last four years. There are in particular the complexities of the problem of the liquid state, which resist as obstinately as ever all attempts to write down a partition function even for the simplest liquid. The authors give an account of the various more or less crude models which have been proposed to describe liquids, and they also develop the theory of Mayer, Born and others about condensation

The recent discovery of the existence of alloys in which an ordered superlattice gradually disappears as the temperature is raised has provided an invigorating incentive to mathematical research on what are known as co-operative phenomena By this term is meant the variation with temperature of the equilibrium state of a body in which the forces holding each molecule in some normal or ordered position depend on the number of its neighbours which are themselves in ordered positions In a sense the fusion of a solid may be regarded as a co-operative phenomenon, but the order-disorder transition in alloys presents a problem which is much more amenable to mathematical treatment, because in an alloy each atom has the choice only of an ordered or a disordered position, instead of the infinite number of positions which are possible for a molecule in a liquid.

The earliest mathematical treatment of any phenomenon of this type is Weiss's theory of ferromagnetism and its disappearance above the Curie point , but the further development of the subject as a problem in statistical mechanics has been hindered by the difficulty of giving a satisfactory account, from the point of view of quantum mechanics, of the interaction between the elementary magnets. The difficulty arises partly from the fact that the elementary magnets, namely, the electrons, do not stay in the neighbourhood of definite lattice points but wander through the crystal In alloys, on the other hand, in spite of the primitive state of our knowledge of metallic cohesion, it is a reasonable hypothesis that the simple assumption of a law of force between neighbours is a sufficient basis for a theoretical attack on the qualitative aspects of the problem. This, at any rate, is the point of view taken in the book under review, and a very full account is given of the various theoretical attempts to set up a partition function for the system, and to find out whether there should be a phase change at the transition point, or whether only the specific heat or even its first derivative is discontinuous

The present reviewer welcomes the appearance for the first time of an account of the Wagner-Schottky theory of lattice defects in crystals in thermodynamical equilibrium Apart from its interest in explaining ionic conduction in crystals, and the importance of the concept for the theory of chemical reactions in solids, the theory has a considerable didactic value. In teaching statistical mechanics to students, it is often advisable to put off the study of gases for as long as possible, because of the difficulty in evaluating the chemical constant, and hence the entropy of a gas, without a much deeper incursion into quantum mechanics than the average student can follow Interstitial atoms or vacant lattice points in a crystal have many of the properties of a gas, but since one can count directly the number of ways in which they can be arranged, expressions for their entropy and free energy can be written down without any appeal to quantum mechanics at all. The present reviewer has found that the subject forms an excellent introduction to the study of chemical equilibria, in the further development of which there is a good deal that the average student has to take for granted.

Readers of Prof. Fowler's earlier books will not need to be assured of the thoroughness with which the work of revision has been done, or of the masterly and complete mathematical treatment of the physical problems which are discussed. Students approaching the subject without much mathematical knowledge will, we think, find it easier than in the previous books to discover the formulæ that they want and to understand the steps by which the formulæ are obtained. The book is written with the needs of practical workers in physics and chemistry in mind, and it is a remarkable achievement to produce a treatise so eminently useful without sacrificing mathematical rigour or completeness in any way.

N. F. MOTT.

PRINCIPLES AND PRACTICE OF EDUCATION

Knowledge and Character

By Dr. Maxwell Garnett. Pp. xii + 358. (Cambridge: At the University Press, 1939.) 18*s*. net.

DR. MAXWELL GARNETT in this book approaches the problems of moral education from the point of view of physiology and experimental psychology. Time was when recourse to scientific method would have meant that the author was committed to a materialistic and determinist interpretation of the mental and moral life But that is no longer the case. Science has shed almost every trace of *a priori* dogmatism, and we find Dr. Garnett frankly advocating the hypothesis of interaction between mind and body as the most reasonable explanation of the facts True, he raises a good many problems of a speculative order which the limits of his space do not permit him to discuss fully. He ranges in the course of his argument over the theory of knowledge and of being, touching also in highly suggestive ways on questions of religion and the ultimate aim of life. We find him speaking of what are strictly psycho-physical generalizations, such as the five formulated in the earlier chapters, and summarized collectively on p. 273, as though they were laws of *thought*; and a good deal of his physiological theory of neurograms, each of which corresponds with varying complexity to a concomitant mental process, is of the nature of highly inferential construction from data that are strictly psychological. Indeed the concept of correspondence which occurs very frequently in these pages seems to us to stand in need of a good deal of detailed explanation. It may well be questioned whether the method of explaining psychological facts by speculative physiological deductions from the very facts to be explained has sufficient logical validity.

An adequate criticism of the book would require a combination of expert knowledge in physiology, psychology and philosophy. The present reviewer can claim competence only in the last-mentioned of the three. In regard to the physiological sections he can but note how carefully documented is the evidence from the highest authorities such as Head and Sherrington. In psychology, Dr. Garnett naturally draws upon his own work in collaboration with Spearman. His mastery of the technicalities of factor analysis, and especially of the *g*-factor, in the mental outfit of the individual, is strikingly displayed in Chapter vii, and should prove most fruitful in the shaping of educational theory.

On the broader speculative issues handled in the last half of the volume, Dr. Garnett's views will doubtless cause some searchings of heart among philosophers. One of the points most open to question is his theory that the soul acts only through the will, and by way of selection and choice between alternative neurograms. It is a little difficult to understand the status of the soul, which seems to be of the nature of a pure ego, in itself unaffected by the development of character, and yet capable of functioning without any physiological correlate. Indeed, in one very interesting note, Dr. Garnett suggests the possibility of direct communion between souls, and again between the human soul and God Such a relationship is presumably purely spiritual. "It is not inconceivable," he says (p. 162, note 1), "that another Soul—God perhaps—or other souls should communicate directly with our souls. In such a case it is possible to imagine that the other soul which communicates with mine does so directly, soul to soul, or indirectly by first causing excitement in my brain. Since, however, my own soul cannot create, but only re-inforce, excitement in my brain, it is not to be supposed that any other human soul has power to *create* excitement in my brain; but we may choose to suppose that God has it, and sometimes exercises it. It is, however, simpler, and therefore preferable, to suppose that all purely psychical communications proceed direct from soul to soul."

In another respect, the adoption of a strictly scientific approach leads Dr. Garnett to lay stress on the importance of psycho-physical generalizations in the training of moral character. As he rightly says, "it is the faith of every science that an unlimited number of phenomena can be comprehended in terms of a limited number of such propositions, principles, or 'laws'. The phenomena are explained as particular examples of the working of general 'laws'." (p. 8)

Now this method is certainly very fruitful when we are dealing with character and conduct on their lower and less complex levels. Then these general rules and laws of habitual behaviour come predominantly into play. But on the higher levels of thought and action, purposes and interests are increasingly unique and individual, defying reduction to any combination of generalities. It is to Dr. Garnett's credit that he frankly recognizes this limitation of scientific method in its application to education. He puts great stress on the development of personality in the individual, who is

moved, in William James's phrase, by "partial purposes and private ends" This is all the more suggestive because of Dr Garnett's frank adoption of the Christian hypothesis (Chapter xv) as making more sense of human experience than any other Christian saints and teachers have always insisted that the element of self-love is ineradicable from human nature, even in the state of perfect consummation in communion with God. Spiritual growth consists in the passage from self-love, detached from love of God, to self-love in and through love of God It is interesting to find repeated confirmation of this cardinal religious tenet in the physiological and psychological positions advocated by Dr. Garnett.

Enough has been said to show the wide range of interest in this volume Dr Garnett brings to his task long experience in educational administration, a wide knowledge of human affairs and a humanistic culture that is rare in a trained man of science. The result is a book that throws light both on educational principles and on their practical applications, as, for example, in the Spens Report, to which frequent reference is made throughout the volume There is an excellent index.

W. G DE BURGH.

SIR JAMES FRAZER'S NOTEBOOKS

The Native Races of America

A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer Arranged and edited from the MSS by Robert Angus Downie (Anthologia Anthropologica.) Pp x+352. (London. Percy Lund, Humphries and Co., Ltd., 1939.) 35*s*.

THE issue of the fourth and concluding volume of extracts from the notebooks of Sir James Frazer, edited by Mr R A Downie, must inevitably provoke certain general reflections on the work as a whole. Among these, the first to emerge in the minds of all will be admiration for Sir James's genius, mingled with a profound amazement at the stupendous energy and industry which have extracted and digested the material apt to his purpose from so vast a literature as has been sampled in these four volumes. With a penetrating insight into the working of what might be termed the 'traditional' mind of primitive man, he has disentangled from an enormous body of recorded fact the significant threads in the evolutionary development of religious beliefs and emotional reactions in a vast variety of forms of the social environment The task has demanded a logical grasp and a power of generalization which have been equalled by the lucidity and persuasive eloquence with which the argument has been presented to the world The supplementary evidence contained in "Anthologia Anthropologica" is no less an integral part of the monument, which is Sir James Frazer's life work, than "The Golden Bough" or "Totemism". For its publication we are deeply indebted to Lady Frazer and the editor, to both of whom Sir James pays well-deserved and graceful tribute in a foreword.

It will be remembered that the principle upon which the contents of these volumes have been selected is that recent sources have been set aside, with a few exceptions, and only the older, less accessible and less known material has been included. Hence from the nature of the material, the extracts present a view of primitive man unsophisticated and as he was to be found in the remoter parts of the world between the sixteenth and latter parts of the nineteenth centuries, but more especially in the eighteenth and nineteenth centuries The conditions in which he was observed by those writers from whom these extracts have been drawn have long passed away, and their record correspondingly is of enhanced significance for the anthropologist

This consideration is of special application in estimating the value and interest of the extracts which deal with America. They are records, of which some were familiar to a past generation of anthropologists, but with the development of new methods and a new outlook in America, now receive less consideration than they deserve. Such are for example H. Rink and Hall on the Eskimo, and the valuable reports over a series of years of the Ethnographical Survey of Canada, unfortunately interred in the Annual Reports of the British Association. Here also is much of the early work of F Boas on the Kwakiute of the north-west, of J. Teit on the Thompson Indians of British Columbia, and the valuable Reports of the Jesup North Pacific Expedition. It is, however, in its earliest records that the literature of indigenous America is at its best, and although "The Golden Bough" has drawn liberally on these sources, it has been possible to add much from Sahagun, Valdes, Herrera, and Ariaga on the extirpation of idolatry in Peru, and other early

Spanish writers who were in a position to obtain or give first-hand information on pre-conquest or early post-conquest peoples in Central or South America—material of which anthropologists, with the exception of those known specifically as 'Americanists', make too little use.

The records of American peoples, whether early or late, from which these extracts are taken, are of even greater interest than those relating to other parts of the world. Outside America, except for isolated instances, such as the Tasmanians, the people still exist, though their conditions of existence have suffered modification. In North America, excepting in the remote north-west and among the Eskimo, as Harlan I. Smith pointed out some years ago, it is becoming increasingly necessary to employ the methods of the archæologist in ethnographical investigation The transfer of the Indians to reservations has sapped or destroyed their culture, except where special reasons, mostly economic, artificially prolong an attenuated existence. Recent ethnographical studies have had to depend upon the memories of a few rapidly disappearing elders among the tribesmen. Hence the value of even the scantiest record of earlier conditions.

A map of "Some Indian Tribes of North America" is included. It is too incomplete to be of much value as a guide to the text and is unworthy of the care which has been lavished on the production of this and the three earlier volumes.

The fifty-five notebooks containing the material, written in Sir James Frazer's own hand, and the product of more than fifty-two years of unremitting labour, from which the extracts appearing in the four volumes of "Anthologia Anthropologica" have been taken, have now been accepted for custody by the British Museum (Bloomsbury)

THE PLANT ALKALOIDS

The Plant Alkaloids
By Dr. Thomas Anderson Henry Third edition Pp viii + 689. (London J and A Churchill, Ltd, 1939) 42s

IN spite of the fact that modern fashions in chemical research have inclined towards the hormones and vitamins, much work has been accomplished during the past twenty years in the field of the plant alkaloids. This fact is reflected in the third edition of Henry's "Plant Alkaloids", which to all intents and purposes is a completely new book. It bears little relationship to the second edition published in 1924, although the arrangement of the material on the basis of a chemical classification according to the nuclear structure has been retained. Slight deviations from this plan occur where important biological relationships would be obscured by a slavish adherence to such a plan. On the other hand, the reader is warned against placing too much reliance on such relationships in considering possible structures of new alkaloids with the reminder that sparteine, long known as the characteristic alkaloid of broom tops (Leguminosæ), has also been found to occur in *Anabasis aphylla* (Cheniopodiaceæ) and as an associate of chelidonine in the greater celandine (Papaveraceæ).

The fascinating problem of the biogenesis of alkaloids is illustrated by reference to many of the experiments conducted by chemists under so-called physiological conditions—at temperatures about 25° C., in presence of feeble acidity and using materials known to occur or to be capable of formation in the plant Those of Robinson involving the conversion of lysine and arginine into hygrine, and of Schopf and others on the synthesis of tropinone, pelletierine and lobelanine are typical examples Such work necessarily follows progress in the correct diagnosis of molecular structure.

Special reference should be made to the section on the alkaloids of cinchona Numerous and complicated as they are, the efforts at chemical diagnosis have been successful and in many cases confirmed by synthesis. The complex problems of stereochemistry have been solved and it is natural that the literature covering this field is very voluminous. Dr. Henry, himself an outstanding figure in this work, has managed to condense the matter available into digestible proportions. There is no better summary of the cinchona alkaloids than that found within the pages of this volume.

Probably no other department of chemical endeavour has given rise to so much controversy as the structure of certain of the alkaloids Mention of morphine, strychnine and berberine emphasizes this point. The author has given a critical account of all the important work on alkaloidal structures and has managed to escape being didactic, whilst giving reasoned assistance in the formation of opinion as to the merits and demerits of opposing contentions. In this respect the book should receive a welcome from all concerned, from the research worker to the honours student.

The pharmacology of the alkaloids has been adequately reviewed, much of the exact work being of recent date. This section has been read critically by Dr. White and will be useful alike to the chemist and the pharmacologist. The importance of such work reaches beyond the confines of the 'pure' pharmacologist on account of the comparatively modern endeavours to relate pharmacological action with chemical and physical properties and thus with molecular structure; that is, chemotherapy in its widest sense not limited by the hampering definition of being concerned only with those products which attack an invading organism. Dr Henry has directed attention to this aspect of the problem by reference to the work on esterified amino-alcohols as cocaine substitutes in local anæsthesia and to the modified cinchona alkaloids. Such work attracts both the pharmacologist and the chemist, and hence it is a great convenience and help to have chemical and pharmacological summaries and references treated in a single book.

Even a work of this size is inadequate to deal with all facts of alkaloidal work, and some selection was imperative. In this connexion Dr. Henry has rightly chosen to deal very briefly with the methods of extraction from the plants and has been content to refer to the more important papers concerned with the chemical and biological determination in plants and plant extracts. Sufficient references are included to help those interested in this aspect of the subject

The value of such a work as this depends largely upon the bibliography: this is remarkably complete and includes references published little previous to the date of issue. Numerous tests for the presence or absence of references were made, but in no case was the book found wanting.

In conclusion, this work forms a perfect reference book in its subject, and even if criticism were possible, to criticize would be an act of sheer ingratitude. The enormous amount of work involved in the collection, correlation and interpretation of the huge mass of material available represents scholarship of a high order.

W. H. LINNELL.

STRUCTURE AND FUNCTION

Life and Living

By Frederic Wood Jones. Pp x + 268 (London: Kegan Paul and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THOSE who have had the opportunity of admiring Prof. Wood Jones's facility and effectiveness as a lecturer will be grateful to him for the publication in a book of some of his recent public lectures His style of lecturing is particularly well adapted for reproduction in the form of written essays, and these make exceptionally pleasant reading.

While dealing with a variety of subjects, the lectures concern themselves mainly with problems of medical education, and with biological problems raised by the consideration of the relation between structure and function. Biologists who have devised theories to explain the structural organization of living creatures have usually appreciated the difficulty of linking structure and function in a common theory of causation. These contrasting aspects of biological study have in the past, indeed, led to an artificial separation of the two scientific disciplines anatomy and physiology, and this again has inevitably encouraged a somewhat dualistic conception of living organisms. Prof. Wood Jones is intent upon the destruction of such an illusion, and would re-orientate the teaching of anatomy so as to stress the fact that structure is only the ultimate expression of function.

Prof. Wood Jones's own views are frankly Lamarckian For him the precision and consistency with which structures, developed in embryonic life, are adapted for their ultimate function are not intelligible unless the inheritance of acquired characteristics is postulated. Yet even he finds remarkable instances of a disharmony between structure and function. The formation of a median vagina in marsupials, according to his interpretation, was a last-minute effort on the part of Nature to avert a catastrophe which was nearly brought about in metatherian evolution by the fact that the initial vaginal canals were too small to allow parturition to occur. He conceives, also, that by some sort of morphological accident the vertebrate eye during early phylogenetic development became caught up with the infolding medullary tube and inadvertently buried. By good fortune, however, it managed to "struggle" towards the surface again, but only at the expense of becoming inverted, and therefore less perfect as a piece of apparatus than it might have been.

Such instances are here quoted to illustrate the fertility of the author's mind, a fertility which expresses itself in many original ideas and novel interpretations. We cannot but feel that all biologists and many other scientific workers will derive very considerable pleasure and intellectual exercise from reading these lectures.

SCIENCE AND PRACTICE OF FODDER CONSERVATION

The Science and Practice of Conservation
Grass and Forage Crops. By Dr. S. J. Watson. In 2 vols. Vol. 1. Pp xi + 415. Vol. 2. Pp vii + 417–820 (London: *Fertiliser and Feeding Stuffs Journal*, 1939.) 2 vols, 30*s*

FARM animals are wintered on fodder and root crops, supplemented by concentrates, that is, grain, milling offals, oil-seed residues, etc; the fodder, roots, and frequently the grain also are home grown. The preservation of the fodder crops, for use in the winter, presents more difficulties than that of the other home-grown foods, and the quality of the product is very variable, depending on the kind of crop, its stage of maturity when cut, etc. The quality of the product is important, because it governs the amount and kind of concentrates that have to be purchased.

Two recent developments, the improvements in the technique of making silage, and the application of artificial drying to grass and other fodder crops, have aroused much interest among farmers and research workers in fodder conservation, since they have resulted in widening the range of crops for preservation, and also in making it possible to preserve them at a younger stage, these developments have brought within reach of the farmer fodders of higher nutritive value, and with a greater proportion of proteins

On the Continent of Europe, the new and improved methods of making silage have resulted in the preservation, for use in winter, of large areas of clover, or of grass and clover mixtures, while in Great Britain interest has been aroused in the conservation of young pasture grass by artificial drying, and by ensiling. Young grass contains up to 20 per cent, or more, of crude protein in the dry matter, and its conservation would dispense with the need for purchasing most of the concentrated foods now fed to cattle, sheep and horses.

It can be readily understood how important this possibility is in a country like Great Britain, which is so suited by climatic and other conditions for producing grass Even in the United States, where there are such ample supplies of grain and of some oil-seed residues, much interest is shown in the possibility of reducing the requirements of concentrates by improvements in the quality of fodders.

Dr. S. J. Watson, in "The Science and Practice of Conservation", has brought together, from all parts of the world, the results of research and practical experience in fodder conservation, and the two volumes present an excellent account of the state of knowledge on all aspects of the subject. The first volume deals with the various processes of conservation, natural drying, artificial drying, and ensilage; separate chapters are devoted to the losses of nutrients in each of these processes. The author directs attention to the heavy rate of losses in haymaking, pointing out that the losses are really heavier than are commonly supposed because of the failure to realize that the actual loss of feeding value exceeds that of the dry matter, since the material lost is the most digestible part

Silage-making occupies a large share of the volume. Before discussing the old and the new methods, the author deals fully with the principles underlying the making of silage. Although the crops for ensiling and the climatic conditions vary from one country to another, the fundamental requirements of successful silage-making are the same, and this volume gives the research worker the type of information that will help him to solve the problems involved in directing the chemical and biological changes in the material in the desired direction.

The second volume deals with the nutritive values of the various conservation products, and contains accounts of the numerous feeding trials reported in the literature. One chapter is devoted to the effects of conservation products on dairy produce, a subject of great importance in peace time in those countries exporting cheese and butter. The last chapter is devoted to the place of conservation in agricultural practice at home and abroad, and deals also with its effect in cheapening the costs of foods for human consumption, and in improving their quality with regard to the health of the nation.

Dr. Watson, by reason of the large amount of research that he has carried out on this subject at Jealotts' Hill, and of his contacts with the practical aspects of the problems, is well qualified to undertake the writing of such a work. Both volumes are of great value to all those interested in fodder conservation, and can be particularly recommended to those engaged in research investigations touching any aspects of this subject.

E. J. ROBERTS.

THE BRITISH EMPIRE CANCER CAMPAIGN

BY DR. E. BOYLAND,
THE ROYAL CANCER HOSPITAL, LONDON

THE publication of the sixteenth annual report of the British Empire Cancer Campaign was very little delayed by the outbreak of hostilities, and the report has appeared in its usual form and is actually larger than it has ever been before During the War as much cancer research as possible will continue, so long as the scientific workers concerned are not all required for emergency work There is no doubt that the greatest progress in cancer research has been made in Great Britain and in the United States Government support and large endowments in the United States are likely to increase American cancer research in the future, and it is to be hoped that the British effort will not fall off

Among the clinical accounts in this report is a description by Mr. J P Lockhart-Mummery and Dr C E. Dukes of the familial adenomatosis of the colon and rectum and its relationship to cancer Adenomatosis is an inherited disease, which is not generally manifested until childhood or puberty. The malignant disease which frequently develops from this adenomatosis occurs at a relatively early age and often has multiple foci of carcinoma The adenomatosis appears to be transmitted by both sexes, probably as a Mendelian character

Much of the clinical work describes the results of radiological treatment. Such material is given in the reports of the Westminster Hospital, St. Bartholomew's Hospital, the Marie Curie Hospital and the Mount Vernon Hospital One interesting development of research on radiations is the discovery of the rhythmic or periodic variation in their action on colloids If colloidal solutions of carbon, graphite, quartz, gold or albumin are irradiated with a certain dose of neutrons, X-rays, γ-rays or by ultra-violet light, they are coagulated, but if the dose is increased by a certain amount no coagulation occurs. With increasing amounts of radiation, the effect on coagulation alternately increases to a maximum and then falls to zero This appears to be a periodic phenomenon analogous to the formation of Liesegang rings, and it would be extremely interesting to know if the same periodic variation occurs in the irradiation of living tissues.

At the recently formed Cancer Research Centre of the University of Oxford, Dr I Berenblum, Dr. E. Chain and Dr. N. G. Heatley have investigated the metabolic activities of very small amounts of surviving skin epithelium in a micro-respirometer This tissue shows aerobic glycolysis and has a respiratory quotient of 0·7, properties which at one time were considered to be peculiar to tumour tissues. In fact, the current report from the Royal Victoria Infirmary, Newcastle-on-Tyne, contains the following rather misleading statement "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues First the ability of cancer cells to form lactic acid persists even when the tissue is respiring, secondly cancer tissue has a respiratory quotient indicating that the oxidation of carbohydrate is abnormal." Since Warburg discovered that slices of malignant tissues produced lactic acid from glucose in the presence of oxygen, retina, smooth muscle, striped muscle, liver, cartilage, bone marrow, lymph glands, kidney medulla and skin have also been shown to glycolyse aerobically It is therefore impossible to consider this characteristic to be peculiar to tumours Neither is the lowered respiratory quotient specifically characteristic of malignant tissues

It was known that the magnitude of respiration and glycolysis did not vary greatly in tumours of different rates of growth, and now Dr. E Boyland and Mrs M E Boyland have shown that this holds even with enormous variations in growth-rate and that it is possible to inhibit the growth of sarcomata in mice without significantly reducing the respiration and glycolysis as measured *in vitro*. Thus the largest metabolic processes do not vary with rate of growth ; this suggests that some tumours must be extremely inefficient in obtaining energy for growth from carbohydrate

Experiments on carcinogenesis are described in several of the reports. At St. Bartholomew's Hospital, 1 · 2 5 . 6-dibenzanthracene in olive oil was introduced into the stomachs of mice in an attempt to produce cancer of the alimentary tract No alimentary tumours were produced but 95 per cent of those mice which survived the period of injection died with pulmonary tumours. Only minute amounts of the carcinogenic compound could have reached the lungs, and the experiment indicates that the lungs are very sensitive to the tumour-inducing action of dibenzanthracene and that the tissues of the alimentary canal are very resistant.

Other experiments showing the amounts of carcinogenic agent necessary for tumour production were carried out by Dr. P. M. H. Browning at

Glasgow. In these the injection of 0·0025 gm. of 2(*p*-amino-styryl) 6(*p*-acetylamino benzoylamino) quinoline methoacetate ('Styryl 430') into mice was necessary to produce sarcomata, while even with 0·0005 gm a small coloured depot may be found more than a year after injection Many other trypanocidal compounds related to Styryl 430 have been tested, but as yet this is the only known compound of its type with carcinogenic activity

Mr. J. C Mottram, at the Mount Vernon Hospital, has used the sensitivity of Infusoria to demonstrate the photo-oxidation of carcinogenic compounds On the whole, the carcinogenic compounds are easily oxidized in ultra-violet light to water-soluble toxic products, and there is rough but not exact parallelism between this action and carcinogenic power Similar results were obtained some years ago by Dr E Boyland, who examined the effect of photo-oxidation products on the enzyme lactic dehydrogenase The chemical changes which carcinogens undergo in ultra-violet light in the presence of oxygen are still obscure, but Prof J. W. Cook and Mr R. Martin of the Royal Cancer Hospital have isolated the photo-oxide of 9 . 10-dimethyl-1 . 2-benzanthracene The parent hydrocarbon, 9 10-dimethyl-1 2-benzanthracene, has very high carcinogenic activity, producing epithelial tumours in mice in thirty-five days ; 5 . 9 · 10-trimethyl-1 : 2-benzanthracene, however, is now the most active compound and has given skin tumours in thirty-one days in tests carried out at the Royal Cancer Hospital. Derivatives of 1 · 2-benzanthracene with substituents in the 9 and 10 (*meso*) positions not only give more stable photo-oxides but also more stable maleic anhydride derivatives ; thus Dr. L D. Parsons and Mr. F. L Warren find that the α-β-endosuccinate of 9 : 10-dimethyl-1 . 2-benzanthracene is very stable and is not carcinogenic, while the corresponding derivative of methylcholanthrene dissociates and is actively carcinogenic. These results indicate that the action of these water-soluble carcinogenic compounds is due to their ability to dissociate and liberate the parent hydrocarbon after injection rather than to the action of the water-soluble compound *per se*. These water-soluble carcinogenic compounds cause lysis of red blood cells *in vitro*, but this action is also shown by similar derivatives of some compounds which have no carcinogenic action.

Dr. P. A. Gorer at the Lister Institute has investigated immunity within pure lines of inbred mice. While it is relatively easy to produce immunity to a tumour in mixed stock animals it is extremely difficult to demonstrate immunity within a pure line. With two types of leukæmia which have been maintained in the pure lines in which they arose, it has not been possible to produce immunity within the homologous pure strain The response of grafted embryonic tissue is similar to that of neoplastic tissues and different from that of placental tissue, which will not grow even in mice of the homologous pure line ; but in general the defence reactions to implanted tissue are governed by genetically determined antigenic differences between the implanted tissue and the host Experiments on resistance to the Jensen rat sarcoma carried out at the Middlesex Hospital by Prof S Russ and Dr G M Scott have shown that the immunity induced by treatment of tumour-bearing rats with X-rays is inherited by the offspring This appears to be an example of inheritance of an induced or acquired character

By far the largest individual account in this year's report is that from Dr P. Stocks, of the General Register Office, Somerset House, on the distribution of cancer of various organs in England and Wales This account, which is the third and concluding instalment, deals with the cancer mortality of the female population and is more of the nature of a scientific paper than an interim report of work in progress The standardized mortality ratios for separate towns and counties have now been computed and the results are given in a series of tables and maps As would be expected from analogous investigations, the mortality from cancer of all sites varies much less than the mortality due to cancer of particular sites. Thus the cancer mortality of part of Wales (Anglesey, Carnarvon, Denbigh, Flint and Merioneth) and of Lincolnshire is higher than that of the rest of the country ; but the excess mortality is only of the order of 15 per cent. The high cancer mortality of North Wales is entirely accounted for by an excess of stomach cancer, affecting both sexes. Dr. Stocks suggests that this excess, which is about one and a half times the expected mortality, is due to dietary factors It is hinted that the bulk of the North Wales population does not consume sufficient vegetables and fruit, and uses the frying-pan too frequently. If this mortality from gastric cancer could be reduced, people escaping might contract cancer at some other site, which might be more amenable to treatment, and some of them would probably avoid cancer altogether.

In the results are several examples of low mortality from cancer of one particular site being compensated for by excessive incidence at some other site. Thus there is a high incidence of uterine cancer in the north-east of England, and in this area cancer of the breast is correspondingly low. Analogous differences are found in the social classes. The incidence of cancer of the uterus in married women decreases steadily with rise in

social class, while cancer of the breast is more frequent in the upper classes. This may be connected with birth-rate, as fertility varies inversely with income. Also it is known that countries with high birth-rates tend to have higher relative proportions of uterine and lower proportions of breast cancer; cancer of the mouth, pharynx, œsophagus, skin and vagina, like uterine cancer, are more common in the lower classes, while cancer of the ovary and thyroid, like breast cancer, are more common in the upper classes.

For almost all sites of cancer that are examined (except cancer of the ovaries) the urban incidence is higher than that in rural districts. The figures for cancer of the lung in different districts are difficult to explain, the incidence being very high in Manchester, Leeds, Sheffield and Birmingham, but low in other towns in Lancashire, Durham and Stoke-on-Trent.

The results of Dr. Stocks's investigations have been dealt with at some length partly because it is conceivable that men of science who are not specially working at the cancer problem might see some explanation of the regional distribution of cancer mortality. Such explanations might give rise to fruitful research on the cause of the disease at a particular site.

Until the outbreak of war, British cancer research had been increasing in its extent and effectiveness, as is clearly shown by the annual reports of the British Empire Cancer Campaign. Let us hope that the work will continue and that the present position will be consolidated and extended in the immediate future.

MACROMOLECULES

SOME developments in the chemistry and physics of macromolecules were discussed at a recent meeting of the Plastics Group of the Society of Chemical Industry and the Faraday Society. Many fundamental problems were raised in the papers contributed by Dr. R. Bhattacharya, E. G. Couzens and H. W. Melville, and in the subsequent discussion; only a few can be referred to in the present article.

In the synthesis of macromolecules from vinyl derivatives of the general type $CH_2 = CXY$, much controversy has arisen about the nature of the active polymer molecules which react with the monomer. Two extreme types may be recognized. The monomer may be converted by absorption of energy to a diradical. To each end of this molecule monomeric molecules may add on, giving rise to a bigger diradical. This may be called the free radical mechanism. On the other hand, the monomer may merely be excited to an extent such that the addition of monomer is facilitated. In this mechanism there is always a terminal double bond in the macromolecule which is the centre of reactivity. It would now appear that it is possible to polymerize one and the same molecule by either mechanism, depending on conditions.

The difficulty really arises in discovering in any one instance which particular mechanism comes into operation. In gas phase polymerization it is often possible to settle the matter in the following way. Hydrogen atoms or methyl radicals add on readily to vinyl derivatives, such as vinyl acetate, producing a single free radical with which monomer easily reacts to form a linear polymer until two such radicals combine. By altering various parameters, it is then easy to characterize this free radical growth and compare it with the polymerization under observation. If the kinetics are identical, it must be supposed that the latter reaction is of the free radical type. In the photo-polymerization of gaseous vinyl acetate, the kinetics are so different from those of the free radical reaction that it would seem the ordinary polymerization occurs by some double-bond mechanism. The difficulty yet to be solved is how the terminal double bond of the active molecule retains its activity. It is well known that a large number of these molecules, including vinyl acetate, also polymerize in the liquid phase, but so far no similar attempt has been made to discover by what mechanism the molecules grow, though it is of interest to mention that a free radical polymerization has been induced in styrene by the addition of tetraphenylsuccinodinitrile, which dissociates to free radicals in solution.

From the photochemical point of view, vinyl ketones are of especial interest. Both methyl vinyl ketone ($CH_2 = CH.CO.CH_3$) and methyl isopropenyl ketone ($CH_2 = C(CH_3).CO.CH_3$) polymerize on illumination with light at 3000 A., though the former molecule does so much more readily than the latter. Once more this is in accord with the general observation that α-methyl substituted vinyl derivatives are more difficult to polymerize than the parent molecule. Methyl vinyl ketone exhibits rather peculiar behaviour. Like most gaseous ketones, it is decomposed by light, and therefore in considering the mechanism of polymerization, it is not impossible that, besides the two mechanisms mentioned above, another must

be taken into account. The primary products of decomposition may well be free radicals, in which circumstance they may start off a free radical polymerization. Here a comparison of the kinetics of the methyl radical sensitized reaction with the direct reaction shows that the latter reaction does in fact take place by the free radical mechanism, initially started by the photo-decomposition of the methyl vinyl ketone molecule. The product of the reaction is, however, insoluble in all solvents, which points to the fact that the molecule is extensively cross-linked. This is reflected too in the abnormal kinetics of the reaction, in that at high enough pressures the order may be as much as five and the negative energy of activation is a function of temperature, whereas in any ordinary photo-reaction the order is rarely greater than two and the rate may only vary exponentially with temperature. Such kinetics can only be explained by postulating branching of the growing molecules—by what precise mechanism is not known. This is the first simple molecule to be studied in which so-called kinetic as well as structural branching have been observed simultaneously.

This introduces the problem of correlating the properties of macromolecular substances with their structure and mode of synthesis. Even correlation of structure and properties is difficult with natural and synthetic polymers. Probably the two most important groups of molecules to be considered in this respect are (*a*) cellulose and its derivatives, and (*b*) vinyl polymers. In neither case is it possible to account quantitatively for the relatively poor mechanical properties, such as tensile strength and modulus of elasticity, as compared with the values calculated theoretically on the assumption that these properties are wholly dependent on the nature of the primary valencies existing in those macromolecules. This is to be expected to some extent, because in any test it is impossible to determine the properties of an adlineated bundle of molecules in view of the small size of even the largest of such linear molecules. The forces which determine these physical properties must therefore consist largely of an intermolecular variety the magnitude of which is exceedingly difficult to compute.

Matters are much more complicated when an attempt is made to define accurately terms such as toughness, and to correlate this with molecular architecture. Practical experience soon singles out those polymers which are generally recognized as tough, with the result that the consensus of opinion appears to be that toughness is a complicated function of impact resistance, tensile strength, extensibility, Young's modulus and bending strength. Some of these properties are in themselves difficult to determine by unequivocal methods. None the less, it is practicable to gain a qualitative idea of the type of molecule most suitable for any given purpose. Such studies will no doubt eventually provide the material for putting the subject on a more scientific basis. But a useful working criterion appears to be given by the total area under the so-called Schopper curve. This is a curve obtained by plotting the load on a material as a function of the percentage elongation. With those plastics normally regarded as tough, for example, cellulose nitrate and acetate, ethyl cellulose suitably plasticized, the curve rises rapidly and then flattens out over a considerable elongation. The triacetate and nitrocellulose are particularly good in this respect. For the exhibition of high extensibility, however, all these molecules must be plasticized, but experiments with other cellulose have shown that a plasticizer is not really necessary if, say, ethyl groups replace the hydrogen atoms of the hydroxyl groups. Unfortunately, the tensile strength of ethyl cellulose is inferior to that of nitrocellulose. Vinyl compounds, on the other hand, do not show this high extensibility, although vinyl chloride is regarded as being very tough. The great extensibility of the cellulose derivatives can be simulated if appropriate side chains are added to the molecule as in polyvinyl butal, but at the expense of a decrease in tensile strength. The addition of plasticizers does not improve matters, as with cellulose, for then the material loses its resistance to deformation and becomes rubber-like in character.

Progress in this field is greatly hampered by the fact that the molecular weights and molecular size distribution are not known for the majority of these polymers. The viscosity method of Staudinger is the only one which is used extensively for large linear molecules, but the discrepancies brought to light when the results obtained with this method are compared with those from end-group determination and by osmotic methods show that all is not well. In view of these difficulties, attempts have been made to modify the simple Staudinger relationship that the specific viscosity of the solution is proportional to the molecular weight of the dispersed phase, but with only limited success. A striking example of the enormous influence of the solvent is shown by the fact that a twenty per cent solution of cellulose in acetone is easily pourable, whereas a similar solution in dimethyl phthalate forms a stiff gel. Part of the trouble would seem to lie in the sensitiveness of specific viscosity to the distribution of molecular sizes in the polymer. Moreover, it is just this factor which is so important in influencing the physical properties mentioned above. It seems to be a general rule, however, that properties such as tensile strength and Young's modulus increase

to a rough maximum with increase in molecular weight. The absolute value of these quantities depends on the nature of the side groups. Those groups exhibiting relatively small interactions, such as phenyl, lead to weakness, while hydroxyl, formal, acetal groups and chlorine atoms yield stronger polymers even although the length of the carbon chain is identical in both cases

All this work has had its effect on improving natural resins by systematic methods. Shellac may be cited as a typical example. It consists of a saturated pentahydroxy monobasic acid of partially known constitution and molecular weight of about 1,000 As such the substance is of no use as a plastic, but it may be modified to give a great variety of useful products On heating, it may be polymerized to linear molecules of much higher molecular weight That this is due to interaction between hydroxyl groups and carboxyl groups of different molecules is shown by the fact that, if either of these groups is chemically bound to other small molecules, such as by the formation of ethers or esters, this polymerization will not take place. By further heat treatment the shellac may be made insoluble, owing presumably to the cross linking which can occur by means of the multiplicity of hydroxyl groups in the 'monomer'. If, however, these hydroxyl groups are modified by reaction with ethylene glycol, this reactivity is cut down to such a point that cross linking is impeded. The result is that much longer linear molecules may be formed with molecular weights up to 25,000. The polymerized lac is then a tough flexible rubber-like substance. Interpolymerization of shellac with naturally occurring unsaturated resins gives rise to a product similar to drying oils used in paints. Further, such composite molecules may be induced to react with formaldehyde to give complex cross-linked molecules of desirable film-forming properties

CARBON DIOXIDE IN ARCTIC AND ANTARCTIC SEAS

BY DR. G. E. R. DEACON,
"DISCOVERY" INVESTIGATIONS

FOR many years past, Prof. K. Buch of the Åbo Akademi, Finland, has been leading the research on the distribution of carbon dioxide in the sea and its interchange between sea and atmosphere, and lately by a survey of the surface waters of the North Atlantic Ocean[1] he gives a very clear demonstration of the value of his methods.

Less than one per cent of the carbon dioxide in the sea is in ordinary physical solution, the greater part being there as carbonate and bicarbonate ions. First there is an equilibrium between dissolved gas and $H^{\cdot}$ and $HCO_3{}'$ ions, and then between $HCO_3{}'$, $H^{\cdot}$ and $CO_3{}''$ ions, both reactions being influenced by temperature and pressure, and by the concentration of the other ions present, particularly $Ca^{\cdot\cdot}$, $Na^{\cdot}$, $Mg^{\cdot\cdot}$ and $SO_4{}''$. The behaviour of sea water towards carbon dioxide is therefore very different from that of fresh water: it acts as a buffer solution, and a comparatively large volume of carbon dioxide can be absorbed or given up at the surface without much change in the concentration or partial pressure of the part of the gas that is in physical solution

Buch and his collaborators had already reached the important conclusion that the equilibrium between dissolved and combined carbon dioxide is fully determined by hydrogen ion concentration, temperature, pressure and alkalinity (as measured by titration)[2]. if these are known, the partial pressure of dissolved carbon dioxide and the concentrations of $HCO_3{}'$ and $CO_3{}''$ ions can be calculated; and since Wattenberg has shown that alkalinity is in general proportional to chlorine content[3], it is sufficient to know temperature, pressure, hydrogen ion concentration and chlorine content.

Buch's recent observations cover practically the whole of the North Atlantic, from Denmark and New York as far as the Arctic pack-ice; but they were all made during the summer months. His calculations based on pH measurements, amply confirmed by direct analyses, revealed the remarkable fact that the carbon dioxide content of the surface water (free plus combined carbon dioxide), in any part of the extensive region examined, bore a constant relation to alkalinity, and therefore to chlorine content and salinity: expressing the total carbon dioxide of any sample in millimols per litre, he found the expression $\Sigma CO_2 = 0{\cdot}108\ Cl^{\circ}/_{\circ\circ} \pm 1{\cdot}5^{\circ}/_{\circ}$.

This means that the total concentration of carbon dioxide in the surface water was controlled within very narrow limits until it had a certain relation to the power of the water for combining chemically with carbon dioxide.

Biological activity and vertical mixing with the deeper water will have an effect on this relation:

a diatom outburst will lower the carbon dioxide content, while the upwelling of deeper water or a rich zooplankton will cause an increase. The fact that Prof. Buch's observations were all made during the summer months must therefore be emphasized; and attention given to his reasoning that in winter, when the phytoplankton activity is very small and vertical mixing greatly increased, the carbon dioxide may bear a higher ratio to chlorine ratio $\Sigma CO_2 = 0{\cdot}108 Cl°/_{oo}$ demands) partial pressures of carbon dioxide in the surface water as low as $1{\cdot}6 \times 10^{-4}$ atmosphere—about half the pressure which is needed to satisfy the same relation for total carbon dioxide in the warmer and more saline waters of the temperate region. The partial pressure of carbon dioxide in the air above the ice-edge was 3×10^{-4} atmosphere; but the wind was blowing southwards off the ice and had not reached an equilibrium with the water; by the time it had passed over some 100–200 miles of the open sea, its partial pressure of carbon dioxide was reduced to $1{\cdot}6 \times 10^{-4}$ atm.—as low as that of the water. The air in the polar region—derived from upper-air currents which have their origin in temperate regions—has apparently a normal carbon dioxide content, but in summer at least it is greatly modified during its passage across the fertile Arctic fringe, and even as far south as Iceland and Petsamo, 'Arctic air' can be distinguished from winds of temperate and continental origin by its low carbon dioxide content.

Type of Surface Water	SUMMER Nov. 23–March 18, 1938–39: Number of observations	ΣCO_2 m.mol/l	ΣCO_2 Cl‰	pCO_2 10^{-4}atm.	O_2 % sat'tn	WINTER July 2–Sept 26, 1938: Number of observations	ΣCO_2 m.mol/l.	ΣCO_2 Cl‰	pCO_2 10^{-4}atm.	O_2 % sat'tn
Subtropical (south of 35° S.)	13 11·8° C to 21·5° C	2·04 1·99–2·09	0·104 ±3%	2·8 2·4–3·8	96 93–100	11 11·4° C to 18·6° C	2·08 2·05–2·11	0·107 ±2%	3·2 3·1–3·5	92 89–95
Sub-Antarctic	22 3·7° C. to 17·6° C	2·06 2·02–2·09	0·108 ±3%	3·0 2·6–3·5	98 94–99	17 3·9° C to 12·4° C	2·09 2·07–2·12	0·110 ±2%	3·3 2·9–3·5	94 92–95
Antarctic (north of 57° S.)	17 −1·8° C. to 2·9° C	2·10 2·08–2·13	0·112 ±1%	2·9 2·3–3·6	95 90–99	18 −1·8° C to 2·0° C.	2·14 2·11–2·17	0·114 ±1%	3·3 3·1–3·6	91 85–94
Antarctic (south of 57° S.)	23 −1·4° C to 1·3° C	2·10 2·06–2·13	0·112 ±1%	2·6 2·3–3·6	95 90–102					

This is proved in the Southern Ocean by repeated observations made by the R.R.S. *Discovery II*[4] in the sector between 0° and 20° E., summarized in the accompanying table. In some contrast to the conditions in the North Atlantic, it was found that the $\Sigma CO_2/Cl$ ratio increased from low to high latitudes, and subtropical, sub-antarctic and antarctic waters were found to have their own typical ratios. Extreme values in each zone were found to overlap with those of the next; but there was sufficient grouping about the mean values to give them significance, and the existence of such typical values for each zone is not unlikely because biological activity and vertical mixing depend on sunshine, concentration of nutrient salts, stability of the upper part of the water column, and strength and variability of wind, all of which are to some extent determined by latitude and by the hydrographical conditions typical of the zones. In the part of the subtropical zone that was examined, and in the sub-antarctic zone, the variations of the extreme values about the means were greater than Buch's figure of 1·5 per cent for the North Atlantic, but the upper part of the water column is less stable.

Prof. Buch's papers contain much more information. Although the salinity of the water in a particular region will fix the total carbon dioxide content, the proportion of dissolved to total carbon dioxide will vary with temperature, and the partial pressure of the dissolved gas (the pressure of carbon dioxide in an atmosphere in equilibrium with the water) must show a still greater variation because it depends on the solvent power of the water, which is greater at low temperatures.

Near the Arctic pack-ice Buch found (as the

In the Antarctic sector between 0° and 20° E. the partial pressure of carbon dioxide was not found to fall as low as Buch's Arctic values; but although the figures in the accompanying table appear to be typical of the greater part of the Antarctic Ocean, the conditions in the more sheltered localities are very like those of the Arctic. In such places the $\Sigma CO_2/Cl$ ratio becomes reduced below any value shown in the table, and, for example, in the Bay of Whales in the Ross Barrier, off the west coast of Graham Land, at the edge of the pack-ice after exceptionally long spells of fine weather, and near South Georgia at a time of exceptional phytoplankton activity, the partial pressure of carbon dioxide in the surface water has been found to be as low as $1{\cdot}6 \times 10^{-4}$ atm.—the same as at the Arctic pack-ice.

The only determinations of atmospheric carbon dioxide in the Antarctic appear to be those quoted by Buch[5], from the results of one of Charcot's expeditions to the west coast of Graham Land: ten samples ranged from $1{\cdot}45 \times 10^{-4}$ atm. to $2{\cdot}55 \times 10^{-4}$ atm., with an average of $2{\cdot}26 \times 10^{-4}$ atm.

The *Discovery II* observations show that the low carbon dioxide pressures are likely to be found only in the summer months · in winter the $\Sigma CO_2/Cl$ ratios were so high that even the freezing water had carbon dioxide partial pressures of at least $3{\cdot}1 \times 10^{-4}$ atm

It has not been possible in this short article to do justice to the earlier workers on the carbon dioxide problem, notably Prof. A. Krogh and J. F. McClendon, or to describe recent work in the Barents Sea and the Baltic, and more particularly Prof Wattenberg's treatment of the *Meteor* observations, but enough has been said to show what great opportunities the accurate measurement of hydrogen ion concentration in the sea offers.

It may, for example, be worth while to review what has been done on the relations between animal behaviour and alkalinity in the sea, because carbon dioxide concentration may be as effective in governing shoaling and distribution as hydrogen ion concentration , there are also many outstanding problems relating to the decomposition of plankton that can be re-examined by calculating carbon dioxide concentration from hydrogen ion concentration measurements ; the Discovery Committee's data will help to solve some of them.

Carbon dioxide determinations have also geophysical and climatological interest. Since the ocean has such a tremendous capacity for carbon dioxide, it must, practically speaking, control the carbon dioxide content of the atmosphere, and where equilibrium with the surface water is established the atmospheric carbon dioxide pressure will depend to some extent on biological activity and distribution of nutrient salts ; the low carbon dioxide pressures around the polar fringes in summer give these regions an added attraction. Continental air has generally a high carbon dioxide content , but Prof. Buch shows that modern development can have very little influence on the total carbon dioxide content of the atmosphere, and his figures are refreshing, as his papers are.

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[3] Wattenberg, H., "Kalziumkarbonat und Kohlensäuregehalt des Meerwassers", Wissenchaftliche Ergebnisse der Deutschen Atlantischen Expedition, 1925–27, 8 (1933).

[4] NATURE, **143**, 1033 (1939).

[5] Buch gives the reference Lundegårdh, Henrik, "Der Kreislauf der Kohlensäure in der Natur", Jena, pp 37–38 (1924)

OBITUARIES

Sir Gilbert T. Morgan, O.B.E., F.R.S.

SIR GILBERT MORGAN died after a very short illness on February 2 in his seventieth year. For fifty years he had been engaged in chemical research and probably no other chemist had such wide knowledge of scientific and applied chemistry. A fitting mark of the Jubilee was the presentation to him in July last of the medal of the Society of Chemical Industry, its highest honour ; on this occasion he gave an account of his career and an outline of his researches.

A professor to-day has the advantages of laboratories and equipment such as were never dreamed of by his forebears ; he is more dependent than they were on his research students and collaborators. Morgan was happy in this respect ; he gave full credit, developed the personal side and received the most loyal support. This in part accounts for the great volume of work accomplished.

Handsome, with alert and friendly eye, yet quiet in manner, Morgan had an amiable personality. He was wedded to chemistry, and when not at the laboratory bench or directing research he was to be found working for one or other of the chemical societies. In their more sociable gatherings he had the gracious assistance of Lady Morgan, *née* Kathleen Desborough.

Morgan was a student of Meldola at Finsbury and came under the practical teaching of Streatfield, who has influenced so many chemists. Meldola was then working on dye stuffs and consulting for Read Holliday at Huddersfield, who found a post for Morgan at the end of his college career.

Here a wide field was open for research, and among other tasks, Morgan prepared the ten dihydroxynaphthalenes, which took him four years. He relates that he condensed formaldehyde with phenol to a product which solidified to a clear amber resin. As the material had no value for making colours it was set aside. This was in 1893, and it was not until 1906 that Bakeland patented the process as a synthetic resin and made a large fortune out of it.

In 1894 Morgan became restless in industry and went back to college, graduating at the Royal College of Science under Sir William Tilden and being appointed to the staff there. In 1904 he began the fruitful co-operation with Miss Micklethwait leading to work on organic derivatives of phosphorus, arsenic and antimony.

Morgan passed on to the Royal College of Science, Dublin, where he was at the outbreak of the War of 1914–18. In 1915 he went back to his old firm, now British Dyes, for a short period to help reconstruct

the industry. But in 1916 he returned to academic life and to Finsbury to succeed Meldola, transferring to Birmingham as Mason professor in 1919. In 1925 came what he described as "a State experiment in Chemical Research", namely the decision to form a Government Research Laboratory at Teddington under the Department of Scientific and Industrial Research, with Morgan as its first director.

It was generally felt that no one was better fitted for the task, but opinions were sharply divided as to the nature of the work which could best be carried out there. It is widely accepted now that Morgan made a success of the task, and that when he retired after thirteen years he left the Chemical Research Laboratory as an asset of real value to the nation. The work done by the Laboratory during the first few months of the War has fully justified all the hopes which Morgan had for its future, and it was a keen pleasure to him to hand over the directorship to one of his students, Dr. G. S. Whitby

Morgan organized a variety of work at Teddington, including an installation for high-pressure reactions, a branch of chemistry then in its infancy. His interest in chemical engineering had always been strong, and he did much to develop the autoclave.

Morgan's scientific researches cover so wide a field that any reference to them in detail here is impossible for lack of space. Their very diversity prevented perhaps the highest achievement in any one field, though all were fruitful to a greater or less extent. Morgan's claim to fame rests on broader foundations. He did as much as anyone to place the science of chemistry on a sure basis in Britain. By teaching and research, by co-operation with industry, he inspired men to succeed in solving chemical problems and advanced the national status and prestige in chemistry, pure and applied.

At a moment when most men would have sought ease, he was ready to start again in a new branch of his subject as chairman of the Research Fund Committee, Institute of Brewing. He received numerous honours, a knighthood in 1936, honorary degrees at Dublin, Birmingham, St. Andrews, the fellowship of the City and Guilds Institute, to mention only a few. He was formerly president of the Chemical Society and of the Society of Chemical Industry, and an indefatigable worker on committees.

We have lost his kindly presence and the help of his clear incisive mind all too soon. A life crowded with change and incident may have caused him to live faster than some of us; we could have wished for his ripe counsel in old age.

E. F. ARMSTRONG.

Mr. E. S. Harkness

MR. EDWARD STEPHEN HARKNESS, the American philanthropist, who died on January 30 just a week after his sixty-sixth birthday, devoted his last score of years to administering and sustaining the benefactions instituted by his mother, who founded the Commonwealth Fund in America in 1918. The Harkness fortune was made in Standard oil. It dates from about seventy years ago, at which time Stephen V. Harkness, the father, who was in a small way of business in Cleveland, Ohio, is said to have lent the daring young Rockefeller £1,200. In the present century the example set by Rockefeller in efficient philanthropy inspired the Harkness family. After the death of the father, mother and son made philanthropy their first interest. The elder Mrs. Harkness died in 1926, leaving for the Fund an endowment of about £7,500,000, which sum Edward Harkness later increased to more than £10,000,000. But he also bestowed large personal gifts.

Efforts of the Commonwealth Fund have taken chiefly the lines of education and of public health. In England the first major gift was the fellowships for post-graduate Britons in American universities, the counterpart to the Rhodes scholarships, except that Commonwealth fellows may proceed to any of about twelve universities in America, either between the Atlantic coast and the Mississippi, or on the Pacific coast. The stipend is £600 a year for two or three years; to date appropriations for these fellowships have reached a total of £650,000 Most of the holders have studied science in America—physics, chemistry, biology, engineering. In 1930 Harkness gave to England the Pilgrim Trust, £2,000,000, the first grant from which was given to the building fund of the Royal Institution. The five original trustees of the Pilgrim Trust still serve. A third Harkness philanthropy in Great Britain was the Child Guidance Council, a centre of information upon 'mental health' for children. Recently in Woburn House, the Council is now evacuated to Bath, and is itself at present engaged in an inquiry into "emotional and behaviour problems" of evacuees.

Grants from the Commonwealth Fund in America have taken a general medical turn, following in that subject the pattern of the Rockefeller Foundation, and contributing in the past twenty years about £4,000,000. Part of this sum has subsidized research in trachoma, leukæmia, functions of the kidneys, and bodily resistance to disease. An annual grant has been given to Dr. May Wilson's clinic in New York for rheumatic fever. Large sums have gone on one hand to the advance of medical teaching, and on the other to fellowships for young post-graduates in medicine. Harkness built ten hospitals. In these, mostly in the rural south, as in Virginia and Tennessee, he took a steady personal interest. In one area, Rutherford County, Tennessee, the Fund has for fifteen years served the cause of public health, and has strikingly reduced the death-rate there from typhoid fever, diarrhœa, tuberculosis and puerperal fever together with infant mortality Only a fortnight before Harkness died he announced the enlargement of two of his hospitals in this region. But apart from this medical philanthropy, Harkness will be chiefly remembered in America for his great gifts to Harvard and Yale Universities—about £6,000,000 altogether—for a scheme under which those unwieldy institutions were enabled to build separate colleges—seven at Harvard and nine at Yale—after the plan of Oxford and Cambridge, and at last give staff and students an opportunity to become individuals.

A reticent and diffident man, Harkness used to say he devoted almost as much time to shunning publicity as to studying philanthropy. A widow survives him, but no children WILLARD CONNELY.

[It has been announced that Mr Harkness has left the bulk of his estate, which is believed to exceed 100,000,000 dollars, in trust to his wife. After her death it is to be divided among twelve institutions including: the Commonwealth Fund, the College of Physicians and Surgeons of Columbia University, Harvard University, Yale University, and Atlanta University.]

WE regret to announce the following deaths:

Prof. Alexandre Desgrez, a member of the Section of Free Academicians of the Paris Academy of Sciences, and professor of medical physics in the Faculty of Medicine, University of Paris, on January 20.

Prof. S. J. Hickson, F.R.S., emeritus professor of zoology in the University of Manchester, on February 6, aged eighty years.

Mr. H. I. Smith, formerly chief Dominion archæologist and assistant director of the Canadian National Museum, aged sixty-seven years.

NEWS AND VIEWS

Horace Bénédict de Saussure (1740–1799)

ON February 17 occurs the bicentenary of the birth of the celebrated Swiss naturalist and geologist Horace Bénédict de Saussure. He was born at Conches, near Geneva, in which city he passed most of his life and in which he died on January 22, 1799. As a boy he was a diligent collector of plants and minerals, being stimulated in his studies by his uncle, the naturalist Charles Bonnet (1720–93). At the age of twenty he made his first tour to the glacier of Chamonix, an excursion regarded generally as dangerous. This was the beginning of his many journeys in the Western Alps and his travels in England, Germany, Sicily and Italy. At the age of twenty-two he was given the chair of physics and philosophy at the Academy of Geneva, and this post he held until 1786 when he resigned and was succeeded by his pupil Marc-Auguste Pictet (1752–1825). Among his earliest writings was a volume on electricity published in 1766. Year by year he extended his knowledge of the Alps, and in 1787 on August 2 with Michel Cachet he ascended Mont Blanc. The first Englishman to make the ascent, Mark Beaufoy (1764–1827), reached the summit a week later. In 1788 Saussure spent about a fortnight on Col du Géant and between 1789 and 1792 climbed Monte Rosa, the Breithorn, and other mountains. The upheaval in Switzerland due to the revolutionary movement in France drew him for a time into political life, but in 1794 most of his activities were brought to an end by a stroke of paralysis. From this he never really recovered.

Saussure's great work "Travels in the Alps 1779–1786" was described by von Zittel as a model of clear language, exact observation and cautious reasoning. His "glowing descriptions of the Alpine world removed the prejudice against the 'Montagnes Maudits', and awakened a feeling of enthusiasm for the infinite wonderland of beauty and delight in the higher altitudes of the Alps. Apart from his achievements in science de Saussure may be regarded as the pioneer of a practically new cult in human enjoyment, the love of mountain climbing". As a geologist de Saussure's aim was to observe, and to observe accurately. He examined the mineral composition of the rocks and studied their topographical, meteorological and physical relations on the mountains. He improved the hygrometer and the anemometer and devised a cyanometer and a diaphonometer for comparing the degrees of transparency of the atmosphere at different altitudes Half a century after de Saussure's stay on the Col du Géant, J. D. Forbes visited the same spot and in 1843 he wrote in his "Travels through the Alps of Savoy" that "No system of connected physical observations at a great height in the atmosphere has ever been undertaken which can compare with that of de Saussure. At any time such self-denial and perseverance would be admirable; but if we look to the small acquaintance which philosophers of sixty years ago had with the dangers of the higher Alps, and the consequently exaggerated colouring which was given to them, it must be pronounced heroic".

A biography of de Saussure was published by Dr. Douglas Freshfield in 1920 and was reviewed by Prof. T. G. Bonney in NATURE of February 10, 1921.

Evacuation and the Schools

LORD DE LA WARR's recent speech as President of the Board of Education in the House of Lords in reply to a motion by the Archbishop of Canterbury has been sent out as an announcement of the Board. It is a timely recognition that educational affairs in Great Britain are not as they should be, and that improvements are needed at once. Granting that the wholesale evacuation of children was a necessary and difficult process, more pains should have been taken to cope with the problems to be faced, one of which, now urgent, is an increase of illness at this time of the year. Every schoolmaster knows the dangers of the Easter term. Things have been done in a hurry and in alarm which should certainly be undone. An important school in a non-danger area was closed until further notice and reopened when better sense prevailed; much of the commandeering or use of school buildings for Government officials or civil defence was unwarranted, and its extent has been reduced.

The President of the Board says nothing of buildings long condemned as unsatisfactory and remaining unrepaired. Children lounging about the streets are a nuisance to themselves and everybody else, and rapidly deteriorate. This misguided leisure is being rectified by the allocating of camps and hiring of extra halls. Authorities have been told that children may be admitted to school before protection is completed. The 400,000 at present "receiving no schooling or care at all" present an urgent problem. In some cases "provision has been made and the children are not attending", and it is stated there are those who "bolster up evacuation by keeping schools closed". The announcement of compulsory school attendance for older children is a step in the right direction. Examinations should go on and full-time schooling be made compulsory as soon as possible. Lord De La Warr realizes that "education is not less important in wartime but more so". At a national conference of secretaries of the National Union of Teachers, a resolution was passed warmly welcoming "the decision of His Majesty's Government to enforce compulsory school attendance in evacuable areas no less than in neutral and reception areas".

Evacuation and Science Work in Schools

THE transference of schools from 'vulnerable' to 'safe' areas in Britain, where they now work in conjunction with other schools of the same type, was a necessary part of the scheme adopted at the outset of the War to minimize loss of life in the event of air attacks upon the civil population. Since last September, normal educational work has therefore not been possible for a very large number of secondary school pupils, and whatever gain there may have been for those from towns coming into closer contact with Nature, it is perhaps offset by reduced teaching and laboratory facilities. Even the better equipped of secondary schools cannot be expected to accommodate double the usual number of science classes, and though in many instances the amount of time devoted to science subjects has not been seriously curtailed, the work is often done in unfavourable circumstances, especially as regards the senior work. It is difficult to accommodate all the senior students in the small advanced laboratories found in most secondary schools even when a system of 'double shifts' is arranged, so that practical work has suffered more than theoretical teaching. The standard of proficiency of pupils who will leave school this year to continue at the universities will be examined with much interest. That the experiment of evacuating schools was a wise one, despite the dislocation involved, there can be no doubt, and the authorities are doubtless watching its consequences so far as secondary and higher education is concerned.

Health of the School Child

SIR ARTHUR MACNALTY's report for 1938 on "The Health of the School Child" has been issued by the Board of Education (H.M. Stationery Office. 1*s*. 3*d*.). The introduction considers the circumstances rendering necessary the evacuation of school children from large urban centres of population and its effect upon the school medical service. During the year the nutrition of 1,674,023 children was assessed at routine medical inspections, and 14·5 per cent were found to be excellent, 74·2 per cent normal, 10·8 per cent subnormal and 0·5 per cent bad. During twenty years, improvement in the nutrition of the school child is striking. Thus in Sheffield, compared with 1920, five-year-old boys average nearly 2 inches taller and 3 lb. heavier, and five-year-old girls 1·4 inches taller and 1 lb. heavier; twelve-year-old boys are more than 2 inches taller and 9½ lb. heavier, and twelve-year-old girls 3 inches taller and no less than 12·4 lb. heavier. The numbers of children in receipt of free meals or milk continue to increase—from 535,300 in 1936–37 to 687,855 now—and the milk-in-schools scheme is in operation in 87 per cent of public elementary schools. Much information is given respecting medical inspection and treatment, hearing of children, the school dental service, and the care of the young child.

Rhodes-Livingstone Institute, Northern Rhodesia

A BRIEF note on the work of the Rhodes-Livingstone Institute since its inception in 1937 prefaces a contribution on "Anthropology as a Public Service" by Mr Godfrey Wilson in the current issue of *Africa* (13, 1; January 1940). This Institute, it may be remembered, was founded largely through the efforts and interest of Sir Hubert Young, then governor of Northern Rhodesia, and was the first institute for systematic sociological research to be established in colonial Africa In the words of the founders, it was intended "as a contribution to the scientific efforts now being made in various quarters to examine the effect upon native African society of the impact of European civilization." In the first instance, funds were asked for three years only, with a view to a special appeal in 1940, a year specially linked with the two men whom the Institute commemorates. It is the centenary year of Livingstone's departure for Africa and the jubilee year of the foundation of the two Rhodesias by Cecil Rhodes.

The Institute is not a Government department but an independent body governed by trustees. Although for the moment the bulk of the income is derived from Northern Rhodesia, contributions are made by all the Governments from Southern Rhodesia to Uganda. Not only has the museum founded in memory of Livingstone in 1934 been incorporated in the Institute, its curator acting as the secretary, but also two research officers have been appointed, of whom Mr. Wilson is one, and the results of their investigations will be published in a series, the *Rhodes-Livingstone Papers*, to which non-members are also invited to contribute.

Pioneers in Amerindian Portraiture

THE February issue of *Man* is a Catlin centenary number, and Mr. L. J. P. Gaskin recalls that on February 1, 1840, George Catlin, artist, traveller and ethnographer, opened his North American Indian Museum and Gallery in the Egyptian Hall, Piccadilly,

London (see also NATURE, January 27, p. 158). Catlin was a self-taught artist and ethnographer. By contrast, Paul Kane (1810–71) was an artist by training and profession, and in his home in Toronto he had been familiar with the appearance and dress of Indians of various tribes who visited that seat of government. After travelling in the United States and studying in Europe, he set out on the first of his two expeditions among the Indians in 1845, when he spent five and a half months in recording portraits of "the principal chiefs, and their original costumes to illustrate their manners and customs, and to represent the scenery of an almost unknown country" In 1846 Kane started on his second and more important journey, which occupied two years and six months and extended across the continent to Fort Victoria He did not keep a journal during his travels, and his book "Wanderings of an Artist among the Indians of North America" (1859) appears to have been written from memory.

Kane's sketches, exhibited on his return, attracted much interest, and a number of pictures were commissioned from him, some by the Government. Some of his pictures are now in the National Gallery, Ottawa, the House of Commons, Ottawa, and the Royal Ontario Museum of Archæology, Toronto. Of his field sketches, some are likewise preserved in Toronto, while a number are in the possession of David I. Bushnell, jun Reproductions of these have now been published with an account of the artist's life and work by the present owner (*Smithsonian Miscell. Collect.*, **99**, 1; 1940). They show a number of variations, important in an ethnographical sense, from the studio portraits and studies painted later.

Tibetan Ceremonial and the Dalai Lama

SINCE the revelation of the reincarnation of the late Dalai Lama in the body of a small boy and his entry into Lhasa, further observances of the ritual ceremonial have affirmed the youthful succession in his position—in this instance all the more necessary in view of the slight discrepancy between his age and the period of time that has elapsed since the death of his predecessor. Among these is the assumption of the new name or names by which the Dalai Lama will be known officially in future. These are, it is stated (*The Times*, February 9), Jampel Ngawang Lobsang Yishey Tenzing Gyatso, of which the meaning is "Tender Glory, Mighty in Speech, Excellent Intellect, Absolute Wisdom, Holding to the Doctrines, and Ocean-Wide". These names derive from titles of former Dalai Lamas, including the first, which was bestowed by the Mongol prince Yushi Khan.

Large numbers of Buddhist priests and nuns are now present in Lhasa for the installation ceremonies, and have attended the ceremonial performances which have taken place in the courtyard of the Potala, the vast monastic establishment in which the Dalai Lama resides. The important part of the New Year observance, as with many primitive peoples, and also among the more primitive of the European peasantry even to-day, is the ceremonial of driving out all the evil influences of the Old Year. In Tibet this is of especial significance in view of the element of 'devil-worship' which has been introduced into the practices of Tibetan Buddhism, and the ecstatic 'devil-dances' in which its followers indulge more especially in eastern Tibet.

On this occasion, it is reported in a dispatch from Lhasa (*The Times*, February 12), the dancers, wearing masks representing the heads of stags or bulls and grinning skulls with fangs, enacted the reception for the skeleton dance which was performed by four skeleton dancers, with two attendant death's heads, scattering ashes. A magician wearing an apron of bones and a tall black hat topped with a fan-shaped ornament conjured spells from a skull while spinning in a rhythmic dance, which was the preliminary to ceremonies performed over an artificial corpse, which no doubt represented the Old Year, although this is not stated Fire, as always a purificatory agent, appeared in the ceremonial when pictures of Tibetan devils were burned.

Forgotten Methods of Painting

IN his discourse on "Forgotten Methods of Painting" at the Royal Institution on February 2, Mr. Hesketh Hubbard spoke of the almost forgotten *sfumato* and *botizar* systems of oil painting, and dealt with the method of dusting dry powdered pigment over a sticky mordant which was used by some of the sixteenth and seventeenth century painters for laying certain pigments—a method known as 'strowing'. He outlined the technique of the fourteenth century English painters who worked in water-colour on woven linen; the linen was first saturated with gum-water, and then stretched over coarse woollen and frieze cloths which absorbed most of the colour, leaving the linen transparent after painting. The method of elydoric painting, or painting miniatures in oil whilst the painting ground was submerged in water, and the techniques of encaustic painting were among the topics mentioned.

In his ceaseless search for new pigments, before the chemist rendered him much assistance, the painter had not despised even the food upon his table. The great Paul Sandby himself had converted into pigment burnt crusts and peas that had been cooked to a cinder. Mr. Hubbard said that there is no reason to suppose that the painter has discovered all the manifold uses of his materials; the more media he has at his disposal the less restricted will be the mental outlook of the painter. Every medium of painting shares a frontier with one or more other media. At one point tempera touches fresco; at another it borders on oil painting. Glass painting and enamelling share much in common. It is along these frontiers, in the region of mixed methods, that the painter, in these latter days of painting will, in Mr. Hubbard's opinion, find the most profitable fields for experiment and research. For the same reason, the painter and student might profitably turn their attention, at least in their leisure hours, to some of the forgotten methods of painting.

Lunar Tide in the Atmosphere

THE *Meteorological Magazine* of December 1939 contains a summary by Prof. S. Chapman of his presidential address to the Association for Meteorology at the Washington Assembly of the International Union for Geodesy and Geophysics last September, the subject being the lunar tide in the atmosphere. The author describes the difficulty that was met when the detection of this lunar tide, achieved first by Lefroy in 1842 for St. Helena, was attempted for higher latitudes, which resulted in a succession of failures that was not broken until his own determination in 1918 of the very small Greenwich air tide, from sixty-four years of hourly data. From that year, when the tide was known for three tropical stations and one non-tropical, progress was rapid, and the rate of determination by Prof. Chapman and his assistants was increased threefold in 1930 through a loan of Hollerith machines by the British Tabulating Machine Co. Now the tide has been determined for more than fifty places.

With this number of determinations available for study of the world distribution of phase and amplitude, several interesting peculiarities have come to light; for example, an early maximum is shown at Salt Lake City, San Diego and San Francisco, this being two hours before the upper and lower lunar transits at the last two places, but at the neighbouring high-level stations of Mount Wilson Observatory and Mount Hamilton (Lick) the tide, although similarly small for the latitude, has roughly the normal phase with high tide after the moon's transits, an effect doubtless due to the presence of the great mountain chain of North and South America. Similar effects are, however, not shown by Kodaikanal and Periyakulam, in India, although the heights of those places differ more than do those of the American stations, the differences being as much as 2,249 metres. Equally remarkable is the practically world-wide retardation of the time of high tide in December and January as compared with April or May, in spite of the fact that summer in one hemisphere corresponds with winter in the other. Work has been begun on the determination of the air currents of period equal to half a lunar day that must be associated with the pressure tide; this problem is being attacked with the aid of the long record available at Batavia.

Ultra-Violet and Infra-Red Radiations on the Farm

L. C. PORTER, of the General Electric Company's incandescent lamp department in Cleveland, said, at a meeting of the American Society of Agricultural Engineers held on December 7, that if only electric current becomes cheap enough and suitable equipment is developed, then ultra-violet and infra-red radiations can have many uses on the electrified farm of the future (Science Service, Washington, D.C.). Adaptations of the familiar dull-red glowing electric heaters can readily be made for use in poultry-houses, in barns to keep new-born animals warm, and for the quick drying of hay. The greater compactness and decreased fire risk will give them considerable advantage over present types of equipment. Ultra-violet rays are known to have certain well-marked physiological effects, as in activating sterols to produce vitamin D and in keeping in check the growth in length of plants. For producing well-proportioned plants in greenhouses, the use of a new kind of incandescent lamp is suggested which has a globe permeable to ultra-violet as well as to visible rays.

With these and other lamps in proper proportions, a close approximation to natural sunlight can be obtained with control of duration and intensity not possible under natural conditions. The well-known germicidal effects of ultra-violet rays still await a number of possible practical applications on the farm. They may be used, for example, in dairies and stable buildings, as they now are in hospitals to keep down the germ population of the air. They may be called on to control the spread of epidemics among farm animals, and to check the growth of moulds and other fungi on hay, grain and other products. Their fluorescent effects may aid in diagnosing animal diseases and in examining vegetables and fruits. With Dr. Buttolph, physicist of the General Electric Company, Mr. Porter is publishing some of his suggestions in *Agricultural Engineering*.

Helium Production in the United States

THE developments of the last twenty years in helium production in the United States are described in *Engineering* of January 26. Reference is made to a lecture delivered recently in the College of Engineering of the University of Maryland by Dr. C. W. Siebel, supervising engineer of the Government-owned helium plant near Amarillo, Texas, and to a memorandum issued by the United States Bureau of Mines. The present helium-producing plant at Amarillo has a capacity of 24 million cubic feet of helium of 98·2 per cent purity a year, but it is stated in the Bureau of Mines memorandum that, by installing another production unit in existing buildings, the output could be raised to 36 million cubic feet a year. As the present military and commercial requirements, aggregating approximately 6 million cubic ft. a year, are met by operating the plant at about one quarter of the installed capacity, there is a large reserve for emergencies.

In addition to the Amarillo installation, the U.S. Government owns two smaller helium plants, at Dexter, Kansas, and at Thatcher, Colorado; these are not being worked. They were built by private interests and purchased by the Government in 1937. To supply the Armarillo plant with helium-bearing natural gas, the Bureau of Mines has purchased all gas rights in 50,000 acres of land comprising the Cliffside gas field. It is stated that, on the basis of a conservative estimate, the Cliffside area contains at least 100,000 million cubic feet of natural gas having a helium content of 1·8 per cent. This is equivalent to a reserve of 1,800 million cubic feet of helium, or approximately two hundred times the

average annual production during the last ten years. In addition to the resources at Cliffside, the U.S. Government possesses two helium reserves in Utah, which are being retained for future needs

Mineral Resources of the British Empire

DURING the War of 1914–18 a Royal Commission formed the conclusion that an Empire Development Board was desirable, and there the project has been allowed to rest An editorial article in *Sands, Clays and Minerals* (autumn issue, 1939) urges that no time should be lost in an intensive survey of the mineral resources of the Empire. The War, so far from causing a postponement of such a survey, should hasten it, and the survey must be carried out from a national point of view regardless of the possible financial profit that may accrue from the mining of any mineral. We cannot afford to wait while commercial interests debate the potential profit in a new venture: access to new supplies of a mineral ore may be vital to victory. The writer makes it clear that he is not thinking in terms of politicians and their methods of control In that direction he foresees no hope of initiative. If anything is to be done, technologists will have to get together and do it for themselves.

It is proposed that the scientific men of Great Britain should draw up a scheme of Empire development, communicate it to corresponding groups in the Dominions and Colonies, and then give the plan such publicity that even the dead hand of the politician could not destroy it, and possibly some public-spirited men might launch the venture free from the shackles of official control. Emphasis is laid on the conception of a just minerals policy for the Empire in the peace that is to come, the necessity for preventing the exploitation of resources falling to the wrong kind of private enterprise in which profits are the one consideration, and finally the desirability of making the Empire's mineral resources available to all.

An Artificial Mastoid for Audiphone Measurements

THE *Bell Laboratories Record* of November 1939 contains a paper on the development of bone-conduction audiphone receivers by M. S. Hawley, of the Transmission Instruments Engineering Department of the Laboratories To provide a method of measuring the response of bone conduction receivers under the correct mastoid load, an artificial mastoid was developed. The impedance offered by the mastoid to a bone conduction receiver was measured on a number of people and then a rubber block was designed that presented to a receiver placed upon it approximately the same impedance as the average human mastoid. Since the artificial mastoid is based on average values of mastoid impedance, there may be slight variations in the results obtained with it and with some particular subject. The possible deviations are indicated by a diagram, which shows responses obtained with the artificial mastoid and with one particular subject. At very low frequencies here is an evident slight departure, but over the major part of the frequency range the results are in close agreement. Measurements on the same instruments made over a period of a year have shown very good correlation. Eventually the rubber pad ages and its impedance changes. The replacement of the old pad by a new one is a simple matter, so that the ageing of the rubber pad is not of much consequence. The artificial mastoid may be used in making other tests on receivers in which it is desired that the receiver be coupled to an impedance load equal to that of the head. Such tests include electrical impedance measurements, rattle tests, and non-linear distortion measurements.

Earth Tremor in New Jersey

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has now determined the epicentre of the earthquake of November 14, 1939, to have been near lat. 39° 45′ N., long. 75° 18′ W., which is only 10′ due south of the point suggested as being very near to the epicentre by the Franklin Institute at Philadelphia. The depth of focus is estimated as having been about 25 km.

We are indebted to Prof. William A. Lynch, of Fordham University, New York, for the information that in the summer of 1938 a series of local shocks occurred to the north-east of the above epicentre in the region of lat 40° 8′ N., long. 74° 32′ W., the two most severe of which were on August 23 at 3h. 36m. and 7h. 3m. G.M.T. On the basis of a canvass of volunteer correspondents and observers, the Coast and Geodetic Survey then announced that the intensity of these "apparently did not exceed V according to the Modified Mercalli Scale of 1931" (felt by nearly everyone; many awakened; some dishes, windows, etc., broken; a few instances of cracked plaster, etc.). The earth tremor was not strong enough to be registered on the seismographs at Kew Observatory. "Earthquake History of the United States", part 1 (1938), published by the Survey, lists only four moderately strong earthquakes for New Jersey up to the year 1936. In our previous note on the earthquake (NATURE, Nov. 25, 1939, p. 904) New Jersey was wrongly stated to be one of the New England States.

Central European Observer

WHEN the Czech nation lost its independence in 1620 its cultural life ceased. Yet Comenius and other teachers continued their educational work in exile. To-day, the nation is again under foreign domination, its universities and scientific institutions are closed and its cultural publications no longer appear in the country itself. One has, however, resumed publication in London. From 1923 until the end of 1938, there appeared in Prague the *Central European Observer*, a review in English dealing with science, art, literature and industry and with European affairs generally. In common with other Czech cultural reviews, it suspended publication after the virtual loss of independence in 1938. It is now appearing again as a fortnightly journal "to study, as it had done

in Prague, the problems of the Danubian basin with special attention to the peaceful collaboration of peoples inhabiting it, in the new Europe which must arise from the present cataclysm".

The *Central European Observer* was always well informed on scientific as well as other matters, and gave readable accounts of archæological, biological, chemical, physical and other scientific discoveries and advances made in Central Europe, and its industrial sections frequently referred to new technical applications of scientific knowledge. The first issue of the new series, which retains most of the features of the former *Central European Observer*, contains an article by the late Karel Čapek entitled "The Death of Archimedes".

American University Education

A DECEMBER number of *School and Society* opens with "Statistics of Registration in American Universities and Colleges, 1939", a remarkable survey by the president of the University of Cincinnati. No fewer than 648 institutions are noticed with various comments in detail, and one realizes the vast attendance in a population, perhaps, four times as big as that of Great Britain. The figures, 873,697 full-time students, and with part-time and summer schools, 1,323,874, show an advance on 1938. The United States spends more of its holidays in learning than Great Britain does, though some of the instruction provided and degrees awarded do not reach the British level of attainment. The south-central divisions of East and West and teachers' colleges and technological institutions show the largest increase. In the Freshman Table the trend of the time appears in the 34 per cent additions to engineering, and we are glad to see a distinct though lesser gain in liberal arts. The establishment of a Graduate School of Education at Los Angeles may in time modify the crudities of American films and scenario writers.

Whales

UNDER the title of "Whales, Giants of the Sea", Mr. R. Kellogg contributes to the *National Geographic Magazine* of January a long article on whales and whaling which is specially noteworthy for the detailed notes on the size, appearance, distribution and habits of more than thirty species of cetaceans and coloured illustrations of nearly every species. Each illustration depicts the whale at sea, often feeding, sometimes in contact with its enemy and frequently in schools. These pictures probably constitute a unique gallery and are of considerable value.

Society for the Bibliography of Natural History

AT the annual general meeting of the Society for the Bibliography of Natural History held on February 3, the following officers for 1940 were elected: *President*, Dr. C. Davies Sherborn; *Treasurer*, Mr. Francis Hemming; *Secretary*, Mr. Francis J. Griffin. The Treasurer's report indicated that the Society's financial position is strong; but the need for new members was stressed if the Society is to continue its activities on the present scale. It was reported that a fund has been set up for the publication of facsimiles of rare works, and the president, Dr. C. Davies Sherborn, has started the fund with a handsome donation.

Aftershocks of the Earthquake in Turkey

THESE still continue in considerable numbers and some reach a high intensity. In the Erzinjan area the two villages of Besin and Pulur were destroyed by a shock which killed forty-five people and injured many more on February 3. On February 4, tremors were felt at Ankara, Sivas and Zara, and a village was destroyed, killing ten people and seriously injuring three others.

The Colonial Service: Recent Appointments

THE following appointments and promotions have recently been made in the Colonial Service: M. Halcrow, agricultural officer, Kenya, agricultural officer, St. Helena; T. D Marsh, agriculturist, senior agriculturist, Malaya; F. R. Mason, deputy director of agriculture and fisheries, director of agriculture and fisheries, Palestine; R. Smeathers, assistant conservator, Tanganyika Territory, assistant conservator, Trinidad; T. G. Wood, senior assistant conservator, conservator, Nigeria; R. Coulthard, veterinary officer, senior veterinary officer, Nigeria; R. M. Gambles, veterinary research officer, Palestine, veterinary officer, Cyprus; D. R. R. Burt, lecturer and head of Department of Zoology, professor of zoology, University College, Ceylon.

Announcements

THE Harben Gold Medal for 1940 of the Royal Institute of Public Health and Hygiene has been awarded to Sir Leonard Hill, formerly professor of physiology in the University of London. The Smith Award for 1940 has been conferred on Sir William Savage, formerly medical officer of health, Somerset.

AT a meeting of the Royal Astronomical Society held on February 9, the following officers were elected for 1940–41: *President*, Prof. H. C. Plummer; *Vice-Presidents*, Prof. David Brunt, Prof. Alfred Fowler, Dr. H. Spencer Jones, Sir James Jeans; *Treasurer*, Mr. J. H. Reynolds; *Secretaries*, Dr. R. d'E. Atkinson, Mr. D. H. Sadler; *Foreign Secretary*, Sir Arthur Eddington.

THE annual prize awarded by the Royal Asiatic Society for its universities prize essay has been awarded this year to Mr. Asa Briggs, of Sidney Sussex College, Cambridge. Of the subjects offered, Mr. Briggs wrote on "The Influence of Sea Power on the History of the East India Company".

THE Sixth International Congress for Experimental Cytology, which had been arranged to take place in Stockholm during July 25–August 1, 1940, has, on account of the international situation, been postponed indefinitely.

PROF. BIDHAN CHUNDER ROY, of Calcutta, has been elected president of the Medical Council of India in succession to Major-General E. W. C. Bradfield. Prof. Roy is the first non-official president and the first Indian to hold the office.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 267. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Anthropological Nomenclature

ANYONE who has followed the revelation of new knowledge on Pithecanthropus and Pekin man by Weidenreich and von Koenigswald in the columns of NATURE and elsewhere during recent months cannot but agree with the opinions expressed by Prof. Le Gros Clark[1] If the usual rules of nomenclature are to be followed, the generic name Sinanthropus must now be regarded as a synonym of Pithecanthropus.

Prof. Le Gros Clark's letter raises once more the whole question of nomenclature in physical anthropology. To put the matter briefly, the naming of the forms of recent and fossil man is in a chaotic state, and the misuse of the term 'race' in anthropological literature has long been a matter for adverse comment. Several ineffectual attempts have been made to rectify matters, most of them over-enthusiastic; for example, those of Sergi[2] (1908) and of Pycraft[3] (1925).

To be consistent, the same general principles should be adopted as in dealing with other zoological groups. Differences within the family Hominidæ may be of three or more orders, and in assessing the value of physical (including morphological, physiological, serological) differences the following general principles should be followed.

(1) *Generic* differences involve differences in external or internal anatomical structure. Examples: the differences between a lion (Panthera) and a cat (Felis), or those separating Pithecanthropus from Homo.

(2) *Specific* differences involve no differences in structure. They include differences in bodily proportions (total size or relative differences in appendages); differences in bodily form; constant major differences in coat pattern, or the distribution of pigment in skin and hair. Specific characters are not necessarily associated with geographical range. Examples: the differences between lions and tigers, or between Negroes and Mongoloids.

(3) *Subspecific* (syn. racial or geographic variational) differences are those occurring between the members of a widely distributed species, and are correlated with climatic and other geographic factors, although experimental removal to other localities proves the characters to be usually fixed. Subspecific differences include differences in colour and texture of pelage; variations in length of coat, or of its special peculiarities (manes, crests, etc.) and minor differences in pigmentary pattern: Examples: the differences between the lions of Asia and those of Africa, or between, say, American Indians and typical Mongoloids.

It is essential that the term 'race' in anthropology be synonymized with 'subspecies', and used for no other purpose By so doing considerable confusion at present existing will disappear. Groups of Hominids of lesser rank than subspecies should be designated 'peoples' (*populi*), and this term should likewise be restricted to this usage. Linguistic differences should on no account be utilized alone in physical anthropological diagnosis, though they may carry weight as confirmatory evidence.

Mutants are not synonymous with subspecies, though they may be subspecies in the making. Commonly but single individuals or small family groups (for example, of albinos) are concerned, but sometimes, as in certain lower Primates, whole colonies of mutants occupy certain localities to the exclusion of the normal form. Where a particular mutation is common, it may affect all the subspecies of a given species (for example, partial albinism in the monkey *Kasi senex* in Ceylon).

Interspecific hybridism is unusual, though not unknown in Nature. It is commoner under domestication, hence frequent in Homo, the most completely domesticated of all animals. Fertility of the hybrids will depend on chromosomal compatibility or the reverse

Intersubspecific hybridism is the rule where two subspecies meet in Nature, as on the geographic frontiers, where intermediate types are usually found. Chromosomal incompatibility is lacking; if it were not, the differences would be of specific rank. Geographic separation is normally the only barrier to complete commingling of subspecies, with the consequent swamping of the differences; but in man, artificial barriers, such as caste, constitute additional factors tending to isolate breeding groups.

It remains to apply the above generalizations to the members of the family Hominidæ, both recent and fossil. There seems to be no dissenting voice to the generic separation of Pithecanthropus and Pekin man from other Hominids, but most anthropologists lump all or nearly all the remaining forms under Homo, and even under a single species thereof. It is manifest that, if the above principles are observed, the Neanderthaloids at least require generic separation, and this has already been suggested by some, the name Palæanthropus Bonarelli being available.

Most isolated new discoveries of fossil man are automatically placed under Homo and labelled with a specific name based on the locality of the discovery. This procedure has been very loosely carried out in the past, without waiting for complete examination of the specimen or comparison of its status with known forms. It is generally merely to serve as a label for description of the specimen. For example, we have *Homo modjokertensis*, which, with advancing knowledge, proved to be a juvenile Pithecanthropus, and *H. kanamensis*, based on a mandibular fragment.

On the other hand, many anthropologists, disregarding the rules of nomenclature, relegate all forms of Homo that do not differ structurally from what they loosely term 'modern man' to the sole species *Homo sapiens*, irrespective of geological age, geographical distribution or differences of a specific order.

The problem of the conspecificity of all living humanity has always been a thorny one. Allowing, however, for modern concepts of the status and limits of 'species', there is no reason to assume, as was once done, that acceptance of several species of living Homo necessarily implies a polygenic origin. If we are to be consistent and adhere to the general principles enunciated above, it is impossible to escape the view that there are several 'species' of living man, and several more fossil kinds. Moreover, some, if not all, these species have evolved geographical variants requiring trinomial nomenclature

Many changes will be required if the above argument is to be acted upon, and new definitions will have to be prepared in certain cases. There will, no doubt, be plenty of scope for differences of opinion, but in any event the adoption of this or some similar scheme will assist in smoothing out considerable confusion. Space forbids the discussion of any details here, but one point that particularly comes to mind is the necessity of restricting the term *Homo sapiens* either to 'white man'—in which case Mediterranean, Alpine, etc., will become subspecies of it—or to some particular group of Europeans

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[1] Le Gros Clark, W. E, NATURE, 145, 70 (1940).
[2] Sergi, G., *L'Uomo* (1908).
[3] Pycraft, W P, *Man* (1925)

Scope and Limitations of Physical Anthropology

RECENT statements regarding physical anthropology are full of interest, but they omit the practical issue, which is the definition of a standard. During 1917–18, I was a medical officer employed in Egypt to assess the physical and mental capacity of soldiers, and decide who should be put into front line service and who should be employed in supporting services and in what capacity.

The story of national efficiency soon revealed itself. It is set out in a work of mine called "A Vision of the Possible". Some soldiers saw sufficiently well with glasses, some had some defective hearing on one side, and some had a varicose vein. I did not regard the vast majority of these as physically deficient, and, with the exception of those who had some ear disease, I could not see how anything could have been done to prevent these conditions. A vast number had bad teeth and were relegated at once to a large number of dentists stationed close to the front line, and were duly attended to.

In this respect I think something could be done in the way of national prevention. I believe I am correct in stating that the predynastic Egyptians, the original Hawaiian and Maories and the uncivilized (if it is justifiable to use such a term) Australian aborigines all had good teeth. The recent publication of the elaborate uncultivated diet of the Australian aborigine explains why he lived and thrived where civilized man died of starvation. But the Pharaohs suffered from dental disease, and so do the other races named, since contact with Europeans and different foods.

In the course of my work I realized that if the defects mentioned were regarded as barriers, there would be a sadly depleted army, and I am grateful that the commander-in-chief, Lord Allenby, endorsed this view and our action.

In the course of an investigation made long since, Lang and I found that in most wild animals refractive errors were not common, though certainly met with in some of the marsupials which have almost rudimentary eyes. But gross errors of myopia, hypermetropia and astigmatism were met with in many domesticated animals.

It is more than evident that Le Gros Clark, Mellanby and others have a powerful case for inquiry on the broadest basis possible, for the problem is not simple. But I conclude by stating that if you reject one man for refractive error, another for defect in one ear and so on, you get an utterly false standard of physical efficiency, and for that reason the usual figures given for rejection from the army never make any serious impression on me, as I think they do not express the common sense of the problem.

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Blood Groups of the Angami Nagas

REFERENCE has been made in NATURE[1] to the report of the British Association Research Committee on Blood Groups among Primitive Peoples. The blood group percentages of the Angami Nagas, based on 96 tests, are given as follows:

O	*A*	*B*	*AB*
35 4	34·4	25 0	5·2

These differ greatly from those on the same people published by Capt. Mitra[2], which are as follow:

O	*A*	*B*	*AB*
46 06	38·78	11·52	3 64

The percentage of *B* given in the British Association data is thus more than double that published by Capt Mitra and there is also an appreciable difference in blood group *O*. It is also stated in the British Association report that the blood group results accord with the view of Mr. J. P Mills that the Konyaks are more primitive than the Angami-Rengmas, but if Capt. Mitra's Angami Naga results are compared with those of the British Association on the Konyaks, they appear to be closely similar. They are as follows:

	No.	*O*	*A*	*B*	*AB*
Angami (Mitra)	165	46·06	38 78	11·52	3·64
Konyak (B.A.)	127	45·7	40·2	10·2	3·9

The British Association results, however, confirm the predominance of *A* over *B* in this region excepting among the Thado-Kukis, which I also had pointed out in my recent paper on "Blood Grouping Investigations in India, with special reference to Santal Perganas, Bihar"[3].

S. S. SARKAR.

Bose Research Institute,
Calcutta.
Dec. 14.

[1] NATURE, 144, 714 (1939).
[2] Mitra, P. N., "Blood Groups of the Angami Naga and Lushei Tribes", *Indian J. Med. Res.*, 23 (1935–36).
[3] *Trans. Bose Research Institute*, Calcutta, 12 (1936–37).

Coprophagy in the Wild Rabbit

REPORTS of recent experiments by Madsen[1] and Eden[2] have shown refection to be a normal physiological process in the laboratory rabbit. A few observations collected by me, while studying the ecology and population dynamics of the wild rabbit, suggest that this process also occurs in natural conditions. From Eden's experiments, 54–82 per cent of fæces passed are shown to be normally refected, the advantage of the process to the rabbit being equivalent to "chewing the cud". It is possible that there is a further ecological advantage, which operates under wild conditions.

The population studied by me was that of a warren near Oxford, and a little more than 50 per cent of them were trapped during 1939 and marked in the ear with numbered celluloid disks, so that observations could be made from a neighbouring 'hide' and the individuals and sexes identified by means of a telescope.

Most of these observations (March 1939 to date) were made in the late afternoon, the time when wild rabbits become active and come out to feed. Generally the period of feeding activity is preceded by about half an hour, in which some, at any rate, of the inhabitants are sitting about basking or cleaning themselves. About a hundred observations (15–60 minutes) have been made to date at this hour. Another period of feeding activity is during the late night and early morning, and this is often followed by quite a long period of basking and cleaning, especially in sunny weather, though only about 5 per cent of the population remain to do this, as contrasted with 33 per cent, which is the average proportion observed feeding. About thirty morning observations have been made. In addition, about twelve observations have been made in the early afternoon during the winter. Rabbits may exceptionally feed and bask at this time, according to weather conditions.

In all these observations refection has been observed on four occasions, three times in the early morning and once in the early afternoon. It may seem curious after noting the high proportion of total fæces refected in Eden's experiments, that this was not observed more frequently; but in the first place it evidently occurs largely at night, and secondly most of it probably occurs in the burrows. It may in fact only happen rarely above ground, so that a long series of observations, such as these, is needed to record it at all. It is clear from the observations that little, if any, coprophagy takes place in the evening, even when basking and lying out occur, and that the morning is the more usual time. This is to be expected from the rhythm demonstrated by Madsen. The one afternoon observation may have been due to exceptional weather conditions (see below).

The method of taking the fæcal pellets was not the same in every case, and the rhythm also varied. One doe was watched at 7 a.m. in August; she extended one hind leg, lifted up the foreleg and bent the head straight down. Another doe, watched at the same time, in September, leaned over on one flank and bent the head round and down outside both forelegs. A third, a buck, watched at 2.30 p.m. in December, did the same as the latter without leaning over on the flank. The two does took pellets at the rate of one every 5 seconds for about 45 seconds, while the buck watched in the afternoon took them at the rate of one every 30 seconds for 3 minutes. 'One pellet' may, of course, mean a group of pellets evacuated simultaneously. The fourth instance watched was at another warren too far away for details to be made out well.

The afternoon observation was made during very cold weather, when the ground was frozen and food difficult to obtain. In this way the rabbit's coprophagy may well be of ecological importance, enabling it to do without a supply of fresh food for certain periods. I examined three rabbits, which had lain up in a bury for at least three days (the length of time traps had been set at the entrances) and in each case the stomach contained a small amount of brownish material very different in appearance from a fresh grass meal. This almost certainly consisted of fæcal pellets broken up. They must have been taken some hours before, since they showed none of the usual 'stomach pellet' shape or discreteness well known to me from examination of normal live rabbit stomachs.

Thus during difficult periods or when scared into 'lying up' during trapping operations, the rabbit may increase the degree of refection. It would be interesting in this connexion to have counts of normal diurnal pellets produced under different environmental conditions. The ability of the rabbit to lie up for as much as a week at a time in unfavourable conditions is remarkable and is an important factor in forming policies of extermination. The degree to which refection is bound up with this ability is also important and deserves further attention.

H. N. SOUTHERN.

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Jan. 13.

[1] Madsen, H., "Does the Rabbit Chew the Cud?" NATURE, 143, 981 (1939).

[2] Eden, A., "Coprophagy in the Rabbit", NATURE, 145, 36 (1940).

Growth Behaviour of Plants following Seed Treatment by Organic Mercury Compounds

ALBINISM in citrus seedlings is not uncommon. Frost[1] suggests that its frequent production by some parents may be due primarily to heterozygosis for various genes for albinism, and perhaps to the presence of unstable genes such as occur in cases of variegation in other plants.

Successful control of seedling albinism in citrus has been achieved in Palestine[2] by treating the seeds in a 1 : 1,000 solution of 'Uspulun' or 'Ceresan' in water.

In this connexion, Perlberger and Reichert[3] state that albinism can also be controlled by dipping the seeds in salt solutions of other metals, including lead, copper, cobalt and nickel. From this they argue that albinism in citrus is a constitutional property inherent in the plant, which manifests itself only at germination and is probably due to a disturbance of the enzymatic systems of the plant at this stage. This is borne out by the fact that salts of heavy metals which are known to have an effect on enzymatic systems cause citrus seeds to produce normal seedlings.

An alternative explanation, however, may possibly be found in a recent communication by Kostoff[4] reporting the induction of atypical growth and chromosome doubling in Gramineæ after treatment with the fungicide 'Granosan' (ethyl mercury chloride) It is conceivable that control of albinism is associated with the induction of abnormal mitosis as the result of seed treatment by organic mercury salts

The beneficial effects in respect of germination and freedom from seed-borne diseases following the treatment of seed by organic mercury dusts are well known.

Some curiosity has been expressed at the high yields thus obtained with cotton[5], and the opinion has also been advanced that a factor other than the control of seed-borne disease must have entered into the effect

It would undoubtedly be of interest and importance to investigate this matter more closely in order to determine the correct explanation of these phenomena

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Citrus Experimental Station.
P.O Mazoe,
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Jan 8

[1] Frost, H B, *Hilgardia*, 1, 365 (1926)
[2] Reichert, I, and Perlberger, J, *Bull Agric Res Stat Rehovot Palestine*, 22 (1936).
[3] Perlberger, J, and Reichert, I *Bull Agric Res Stat, Rehovot Palestine*, 24 (1938), (abstract in *Hort Abs* 9, No 3 (1939) only this seen)
[4] Kostoff, D, NATURE, 144, 334 (1939)
[5] Miles, L E, *Phytopath* 29, 986 (1939)

Identity of the Bacterium Causing Potato Blackleg

As a result of the comparative study of Leach[1], the blackleg disease of potatoes is now generally ascribed to *Bacterium carotovorum*, which is also responsible for the soft rots of many of our vegetables and other plants. Previous investigators[2,3,4,5] had described and named slightly different organisms which Leach endeavoured to show were either identical with or at most variants of *B carotovorum* This conclusion was based mainly upon four sets of observations recorded by himself or by others: (1) the similarity of the reactions in dextrose, sucrose and lactose; (2) the proved pathogenesis of authentic strains of *B. carotovorum* when inoculated into potato stems; (3) the isolation of this organism from a soft rotted tuber; (4) the blackening of "potato tissue killed by almost any organism" (Leach).

Lacey[6], however, had shown that the organism isolated from blackleg potato plants produced acid and gas in maltose, a sugar not used by Leach, whereas authentic strains of *B. carotovorum* did not, and furthermore, the latter when inoculated into potato stems produced a white pith rot, but never the characteristic blackening of the cortex caused by the former. Lacey considered these were sufficient reasons for retaining the original name of the organism, namely, *Bacillus phytophthorus* Appel. Bonde[7] has recently investigated the soft rots of the potato tuber in the United States and, following Leach, ascribes most of these to *B. carotovorum* (*Erwinia carotovora* of U.S. nomenclature). Like Leach, Bonde did not include maltose among the sugar reactions investigated but worked only with the same three used by Leach. In his tabulated results Bonde indicates that, while the organisms isolated from blackleg produced the characteristic blackening when inoculated into potato stems, some of those isolated from naturally rotted tubers did not

During the past summer, I commenced a re-investigation of the disease, mainly with the object of trying to ascertain how it is propagated. From blackleg plants collected in various parts of Great Britain and sent to Cambridge for examination by the courtesy of the Ministry of Agriculture and Fisheries, an organism has been isolated which behaves in the manner described by Lacey, that is, produces acid and gas in maltose and the characteristic blackening of the tissues when inoculated into stems of living potato plants At the same time a soft-rotting organism isolated from carrots was used for comparative studies, the results of which confirm those of Lacey, as it produced only wilting upon inoculation and formed no acid in maltose. It seems certain, therefore, that the organism isolated from blackleg is not identical with what is generally accepted as *B carotovorum*, in that the former differs in pathogenesis and in an important biochemical character

The blackleg organism must, therefore, be given a special label, for while it is correct to state that it will reproduce the disease upon artificial inoculation and forms acid and gas in maltose, this is not true of *all* strains of *B carotovorum* It is considered that the differences are good specific characters and that the original specific name should be employed, modified to conform with the generic name Bacterium. Appel's original name was *Bacillus phytophthorus*, but the genus Bacillus can no longer be used for non-sporing rods (Resolution I(*e*) approved by the Second International Congress for Microbiology, London, 1936[8]). and I[9] have stated my reasons for using the generic name Bacterium for the soft-rotting bacteria which are closely allied to the colon-typhoid group and for which this generic name is employed by Topley and Wilson[10]. The name of the blackleg organism should therefore be *Bacterium phytophthorum* (Appel) n. comb.

To sum up, blackleg is caused by a specific organism, *B. phytophthorum*, which also produces a soft rot in potato tubers and other plant tissues. Another and distinct organism, *B. carotovorum*, produces a similar rot in tubers, etc., but not blackleg of potato stems. The former produces acid in maltose, the latter does not. Potato tubers found in a rotted condition may harbour one or both organisms.

W J DOWSON.

Botany School,
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Jan 24.

[1] Leach, *Phytopath.*, 20, 743 (1930)
[2] van Hall, Inaug. Diss Univ Amsterdam (1902).
[3] Appel, *Arb. biol. Abt Land. u. Forstwirt.*, K. Gsndhtsamt., 3, 134 (1903).
[4] Harrison, *Centralbl. Bakt.* (II), 17, 34 (1907).
[5] Pethybridge and Murphy, *Proc. Roy Irish Acad*, Sect. 29B, 1 (1911).
[6] Lacey, *Ann. Appl. Biol.*, 13, 1 (1926).
[7] Bonde, *Phytopath.*, 29, 831 (1939).
[8] St. John-Brooks and Breed, *J. Bact*, 33, 445 (1937).
[9] Dowson, *Centralbl. Bakt.* (II), 100, 177 (1939).
[10] Topley and Wilson, "Principles of Bacteriology and Immunity", 2nd ed., 515 (1936).

Listeria: Change of Name for a Genus of Bacteria

I HAVE been informed that at the Third International Congress for Microbiologists, held in New York City, September 2–9, 1939, it was reported to the Committee on Nomenclature that the name *Listerella*, which I proposed for a genus of bacteria in 1927, had already been given to a Mycetozoan by Jahn in 1906.

My proposed name therefore becomes a homonym, but as the genus has acquired some importance in both human and veterinary pathology and references to "Listerellosis" are becoming fairly common in literature, I think that a name as near to my original proposal as possible is desirable. I therefore propose *Listeria* as the name for the genus of bacteria as defined by me in Publication No. 20 of the South African Institute for Medical Research, "The Plague Problem in South Africa", by J. A. Mitchell, J. H. Harvey Pirie and A. Ingram (Whole vol. 3, p. 169).

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Jan. 16.

Neurosecretory Cells in the Ganglia of Lepidoptera

FOR many years the investigators of metamorphosis in the Lepidoptera have maintained that the source of the moulting hormone is the brain rather than the corpora allata, which Wigglesworth[1] formerly considered to be the organs producing the secretion in the bug, Rhodnius. Recently, however, Wigglesworth[2] has produced evidence which suggests that an area in the pars intercerebralis of the supra-œsophageal ganglion of Rhodnius is responsible for the production of the moulting hormone. As he points out, Hanström[3] had already described modified nerve cells in this same region which are considered, on morphological grounds, to be probably secretory in function. Neurosecretory cells have been described in several other insects, but it has been reported that, in spite of careful search, no such cells could be found in the brain of the moth larvæ (*Ephestia kuehniella*) studied by Schrader[4].

SECTION OF THE SUPRA-ŒSOPHAGEAL GANGLION OF THE MOTH *Eacles imperialis* DRU., SHOWING LARGE FUCHSINOPHIL CELL WHICH IS CONSIDERED TO BE SECRETORY IN FUNCTION. BOUIN FIXATION, GOLD IMPREGNATION FOLLOWED BY MALLORY'S TRIPLE. PHOTOMICROGRAPH × c. 700.

It seems of interest, therefore, to be able to report the discovery of cells very similar to those described by Hanström which I have found in the ganglia of certain Lepidoptera. They have been demonstrated in the pars intercerebralis of the supra-œsophageal ganglion of adult moths, in larvæ of all instars, and in pupæ. They have been found occasionally in the sub-œsophageal ganglia of larvæ, and in certain of the abdominal ganglia, but not in all. These cells have essentially the same staining properties as those of Rhodnius, being apparently modified ganglion cells, from which they differ in containing a granular cytoplasm or a number of droplets which are intensely fuchsinophil. They are well differentiated by Mallory's Triple strain.

They have been most studied in the larvæ of the moth *Ceratomia catalpæ* Bdv. (Sphingidæ), in which they are generally scattered singly, but may be grouped as those of Rhodnius. Although they may vary in number and in their exact position from larva to larva, no indication has been found of a cyclical production of secretion.

Similar cells have been found in the brains of several species of Heterocera belonging to the families Citheroniidæ, Phycitidæ, and Saturniidæ.

In view of the above-mentioned experimental evidence, it seems possible that these cells are the source of the moulting hormone in the moths, but the fact that similar cells can be demonstrated in some abdominal ganglia indicates that further experimental work must be done before a function can definitely be assigned to them. However, the similarity in staining properties of the cells from the brain and the abdominal ganglia does not, of course, necessarily indicate identity of function.

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Harvard University,
Cambridge, Mass.
Dec. 21.

[1] Wigglesworth, V. B., *Quart. J. Micr. Sci.*, 77, 191 (1934).
[2] Wigglesworth, V. B., NATURE, 144, 753 (1939).
[3] Hanström, B., *Lunds Univ. Arsskrift*, N.F., 34, No. 16 (1938).
[4] Schrader, K., *Biol. Zbl.*, 58, 52 (1938).

Zoological Nomenclature

PROPOSAL of a 'stereotyped' zoological nomenclature almost invariably comes from a non-systematist or from a systematist working sporadically on a restricted group in a field where there is but a small literature and few workers. Any active worker in a large and progressive systematic field would realize at once that any 'stereotyping' plan is impossible. In my own subject, ichthyology, there is no general world monograph suitable for 'stereotyping' subsequent to Günther's "Catalogue" (1859–1870), and Günther's classification and nomenclature are now so out of date that no ichthyologist would

accept it. There are a number of large faunal works of more recent date, but if they were 'stereotyped' for particular regions, their nomenclatural differences would force the wide utilization of different generic or specific names in different regions for identical genera or species. The vast number of forms thus affected would preclude any sensible arbitration of the conflicts. Not long ago one eminent anatomist proposed that the vagaries of elasmobranch nomenclature be settled by a return to the 1838 nomenclature of Müller and Henle's "Plagiostomen". But *he did not suggest what was to be done with* the numerous genera and species described since that time and with the various subsequent segregates of Müller and Henle's genera. As a matter of fact, *return to this nomenclature of 1838 would necessitate* the change of more valid names than were contained in the whole of Müller and Henle's work!

Those systematists who sincerely study zoological nomenclature in an effort to find a way of avoiding vexatious changes usually reach the conclusion that Linnean binomial nomenclature will never be entirely stable, since it is firmly wedded to classification and no one can prevent ideas of classification from changing so long as systematic research is carried on. If absolute stability is imperative, we must cast the entire Linnean system overboard. In my opinion, this will never be done.

As a matter of fact, the particular situation which has troubled Prof. Garstang[1] and Dr. Crossland[2] is *not due to the Rules*, but to what *I consider misuse* of the Rules by a small group of Australian nomenclaturists. The nomenclatural *tour de force* to which this group has treated conchology, ornithology, ichthyology, and other fields is deplored by most of the systematists of Europe, America and especially Australia. I am familiar only with the ichthyological side, but in regard to this I can say that comparatively few of these Australian innovations hold water systematically, and many are directly contrary to the Rules. Very likely Prof. Garstang's strictures, if applied to British nudibranchs *in conjunction with full knowledge and correct interpretation of the International Rules*, would restore at least some of the old nomenclature.

I say, at least some. A blind condemnation based purely on personal nomenclatural prejudice is unworthy of consideration in view of the long labours of the many persons who have built up the present International Rules in an attempt to evolve some universal basis for the greatest possible nomenclatural stability in all animal groups. Some general system of rules is imperative, and we have such a system. A great many of the cataclysmic nomenclatural revolutions that occur now and then in restricted groups are due to the utterly irresponsible and capricious nomenclatural practices of past workers. When at last a new and more able generation of workers, cognizant of the importance of adopting a universally acceptable nomenclature, appears, old names by the dozens are likely to fall and older workers to protest bitterly. The latter sometimes fail to realize that they are possibly at fault, or that their particular nook might perhaps need some change in order to make way for a more universal practice.

The present International Rules are not perfect. They have been arrived at only through an enormous amount of work and compromise. How great that work has been, and how difficult it is to obtain agreement on sensible amendments and to prevent the enactment of senseless ones, at the International Zoological Congresses, is largely unknown except to those who have studied the history of the Rules or who have actually been present at the nomenclatural sessions. Some idea of the complexity of points of view that had to be compromised may be gained by reading Dr. Stejneger's paper, "A Chapter in the History of Zoological Nomenclature"[3], and I recommend it to anyone wishing to amend the Rules. But certain improvements might be made without any change in the Rules. Nearly every systematist with whom I have discussed the matter has agreed that the creation of a number of sub-commissions for various animal groups, whose decisions should be subject to reversal only by the main International Commission, would speed up nomenclatural decisions enormously and remove any present causes for dissatisfaction. With several of my colleagues, I hope to present a plan of this sort formally in the near future.

GEORGE S. MYERS.

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Jan. 10

[1] NATURE, 144, 481 (1939)
[2] NATURE, 144, 942 (1939)
[3] *Smithsonian Misc Coll*, 77, No 1

Barkhausen-Kurz Oscillations with Positive Ions

Kownacki and Ratcliffe[1] have previously described an experimental method of investigating electron inertia effects in thermionic vacuum tubes. By replacing the electrons in a triode by positive ions of cæsium, of mass 25×10^4 times greater, they were able to slow down the effective transit times involved by a factor of about 500. In this way they demonstrated the occurrence of rectification effects, dependent upon a resonant transit time, at a wave-length of about 500 metres.

We have now found that it is possible to maintain oscillations of the Barkhausen-Kurz type by using positive ions emanating from a filament. A cylindrical electrode valve of the Type *AT* 40 had some cæsium inserted, and was kept at a temperature of about 30–70° C. with an accelerating potential of the order of 200 volts on the grid and with the anode at zero potential, or at a slightly retarding potential. Under certain conditions of positive ion current, determined by bulb temperature, the valve was found to maintain oscillations with a wave-length of the order of 500 m., corresponding to the time of transit of ions between the electrodes. We satisfied ourselves that the triode alone, with no external circuit tuned to a wave-length greater than about 50 cm. (the natural wave-length of the wire leads), would maintain an oscillation with a wave-length of about 500 m., and the wave-length depended on the electrode potentials employed. The addition of an external tuned circuit greatly increased the amplitude of the oscillation, but had only a second order effect on the frequency. There seems no doubt that the frequency of the oscillations was determined inside the valve itself. Oscillations of this type have often been called true Barkhausen-Kurz oscillations, in contrast to Gill-Morrell oscillations, the frequency of which is mainly determined by an external circuit.

This is not the place to describe our results in detail, but they may be summarized by saying that, at zero D.C. plate potential and with the minimum space current required for oscillation maintenance, the oscillation gave a pure heterodyne note corresponding to a single oscillation with a period approximately equal to one half the time T of ion transit from filament to plate and back, as given by the Scheibe expression[2]:

$$T = 4r_g \left\{ f\left(\sqrt{\log_e \frac{r_g}{r_f}}\right) + g\left(\sqrt{\log_e \frac{r_p}{r_g}}\right) \right\} \Big/ \sqrt{\frac{2e}{M} V_g}$$

Here T is the transit time in seconds, r_f, r_g and r_p are the radii of the filament, grid and plate respectively, V_g is the grid potential in E.M.U., e/M is the specific ionic charge in E.M.U./gm., and f, g are functions given in Scheibe's paper[2]. "Resonance rectification" effects were observed at periods of about T, $T/2$ and $T/3$.

As the space current was increased, the period of the oscillation became increasingly smaller than $T/2$. At a critical space current the type of oscillation suddenly changed, and the single oscillation was replaced by a set of oscillations of slightly different frequencies, which gave an impure heterodyne note. With further increased current the frequencies of the multiple oscillations diverged, and when the condition of space-charge-limited emission was approached, there was an abrupt change to a single oscillation period of rather less than T.

It appears that much information concerning the mechanism of electronic oscillations might be obtained by applying this method of investigation to valves with different electrode structures, and preferably to valves with structures which can be altered without opening up the tube.

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J. A. RATCLIFFE.

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Jan. 22.

[1] NATURE, 141, 1009 (1938).
[2] Scheibe, Ann. Phys., 73, 70 (1924).

Optical Anisotropy of Cellulose Sheet

THE birefringence[1] of 'Cellophane' (regenerated cellulose sheet) has been measured for more than two hundred samples, kindly supplied by the makers. Three main points have emerged.

(1) The birefringence (B) varies with the wavelength of the light used, the law being approximately

$$B = B_0 \ (1 - 0 \cdot 000016\ \lambda),$$

where λ is in angstroms.

(2) Results for the birefringence of the thinnest material (about one thousandth of an inch) vary from 0·0056 to 0·0132, with a concentration around 0·0089. The thicker materials (1·2 and 1·6 thousandths of an inch) give, on the average, lower values of birefringence.

(3) The birefringence is least in the middle of the web, and is about 30 per cent greater near the selvedges.

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Jan. 26.

[1] Drummond, D. G., NATURE, 145, 67 (1940).

Kornerupine from Ceylon: a New Occurrence

SOME years ago we discovered specimens of kornerupine in mixed parcels of typical cut Ceylon gem-stones, and this prompted us to search for the mineral in gem gravel concentrates kindly sent to us direct from Ceylon by Mr. Hans Van Starrex. From the first lot of rough so examined, which consisted mostly of green zircons, two small pieces of kornerupine were recovered, so that yet another species must be added to the already long list of gem minerals found in the Ceylon gravels.

These two specimens, greenish-brown in colour and weighing 0·430 gm and 0·436 gm respectively, have the following properties: density, 3·33; refractive indexes, α 1·671, β 1·683, γ 1·684; 2 V, 25°, $r < v$; α light brown, β yellow, γ dark green. It may be noted that Madagascan kornerupine differs in having r greater than v.

Credit for the identification of our specimens is due to Dr. L. J. Spencer, and confirmation was provided by Dr. G. F. Claringbull, who kindly carried out X-ray measurements.

It is hoped that later a fuller account, together with a complete analysis, will be published in the *Mineralogical Magazine*.

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Blue Rocksalt

SPECIMENS of natural rocksalt are frequently coloured, the more usual colours being blue, violet and pink. Blue halite from Stassfurt in particular has received much attention, and many suggestions have been offered to account for the tint. Siedentopf's[1] theory that the colour is due to colloidal sodium was regarded generally as satisfactory until Spezia[2] pointed out that its solution should then be more alkaline than that of the colourless form—which it is not. Doelter[3] regards the colour as caused by foreign inclusions, colloidal or otherwise, and favours a mixture of iron and manganese, though sulphur and organic substances are not ruled out.

More recently, however, Kennard, Howell and Yaeckel[4] have decided against any pigmental theory, as the result of a spectroscopic examination of a specimen of colourless Stassfurt rocksalt containing a distinct zone of blue. No difference in composition between the coloured and colourless parts could be detected; traces of several foreign elements, including aluminium, lithium, silicon and titanium, were present in both. The authors regard their results as supporting the views of those earlier investigators[5] who have attributed the colour to some structural cause.

Apparently, however, gold has not been specially looked for; it may easily escape detection spectroscopically because it is not one of the very sensitive elements, some 10 p.p.m. being the lower limit of detection by ordinary methods. The *Glimmschicht* procedure, developed by Goldschmidt and his

co-workers, is claimed to be some fifty times more sensitive[6], but does not appear to have come as yet into general use amongst mineralogists.

We have already shown[7] that sufficient gold is present in the blue and reddish-brown translucent celestines from Yate, Glos., to impart the observed colour if the metal is present in the colloid state. It occurred to us, therefore, that possibly blue Stassfurt halite might likewise contain colloidal gold. This appeared possible for two reasons. First, it is known that sea water frequently contains gold and if, during evaporation, this became concentrated locally, it might easily, if reduced to the colloid state, give rise to coloured streaks in the resulting rock salt. Experiment shows that, under favourable conditions, 1 to 4 p.p.m. of colloidal gold suffice to give a decided tint to a crystal although gold chloride would not, in general, be perceptible.

Secondly, Przibram[8] has noted the analogy between the blue tints of halite and anhydrite. Through the kindness of Mr. Arthur Russell, president of the Mineralogical Society, we have been able to examine a blue-tinted specimen of anhydrite from Cropwell Bishop, Notts., and find it to contain 4 p.p.m. of gold, amply sufficient to yield the observed tint.

Messrs. Gregory and Bottley generously gave us some deep blue Stassfurt halite and in it we found an average of 23 p.p.m. of gold, using an *o*-di-anisidine method[9]. This was again amply sufficient to impart the observed colour. We have found gold to be present also in specimens of both blue and pink halite from other localities, including Hallstadt and Wieliczka (Cracow).

Though we hesitate to draw definite conclusions from a mere half dozen analyses, we do venture to suggest, as worthy of consideration, the view that the colour of halite may, in certain cases at any rate, be connected with its gold content.

J. Newton Friend.
John P. Allchin.

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Jan. 27.

[1] Siedentopf, *Phys. Z.*, **6**, 855 (1905).
[2] Spezia, *Zentr. Min.*, 398 (1909).
[3] Doelter, *Monatsh.*, **52**, 241 (1929).
[4] Kennard, and others, *Amer. Min.*, **22**, 65 (1937).
[5] Notably Przibram, Guthrie, Phipps and Brode.
[6] See "Spectrum Analysis" by Strock (Hilger, 1936).
[7] Friend and Allchin, Nature, **144**, 633 (1939).
[8] Przibram, *Chem. Zentr.*, **2**, 753 (1936).
[9] Based on Pollard, *Analyst*, **62**, 597 (1937), and Jamieson and Watson *ibid.*, **63**, 702 (1938).

Points from Foregoing Letters

W. C. O. Hill shows that differences within the family Hominidæ are of three orders—generic, specific and subspecific. Brief specifications of the status of these are given, but it is pointed out that the members of the family are particularly liable to interspecific and intersubspecific hybridism. Nevertheless, a plea for the observance of the same rules of nomenclature as employed by zoologists is made, and an effort thus made to remove some of the confusion at present existing in anthropological literature. The misuse of the term 'race' and the irregular usage of the title *Homo sapiens* are particularly to be regretted.

Although coprophagy has recently been shown to be a normal physiological process in the laboratory rabbit, there are apparently no previous records of it occurring in the wild. Observations by H. N. Southern of a wild population have shown several instances of refection, and the process is probably important in enabling wild rabbits to tide over unfavourable periods, when food supply is short, or when they are kept in their burrows by persecution.

The slightly differing bacteria causing potato blackleg, the first of which was called *Bacillus phytophthorus*, are now considered to be identical with *Bacterium carotovorum*. One organism isolated from blackleg, however, forms acid in maltose and reproduces the characteristic symptoms of the disease upon inoculation, whereas authentic strains of *B. carotovorum* do not. These differences are considered by W. J. Dowson to be sound specific characters, and necessitate a separate name for this blackleg pathogen. As *Bacillus* can no longer be used, the correct name should be *Bacterium phytophthorum*. Both organisms may occur in naturally rotted tubers.

M. F. Day describes modified nerve cells from the ganglia of several species of moths, and suggests that these may be the source of the moulting hormone in these insects.

G. S. Myers discusses the difficulties of rigid application of the International Rules of Zoological Nomenclature. In order to hasten the procedure, he suggests the formation of sub-commissions for various animal groups, the decisions of which would be subject to reversal only by the International Commission itself.

'Barkhausen-Kurz' oscillations have been obtained by W. S. Elliott and J. A. Ratcliffe at a wave-length of 500 m. by the use of heavy positive ions in place of electrons in a cylindrical triode. The production of oscillations did not require the presence of any tuned external circuit, and the frequency was determined solely by the operating conditions of the triode. The Scheibe transit time formula was obeyed in the case of weak oscillations. Various types of oscillation have been found for different operating conditions.

The birefringence of regenerated cellulose sheet is found by R. C. Gray to decrease slightly with increasing wave-length, to vary within wide limits about a mean value of about 0·0089, and to be, at the selvedges of the web, about 30 per cent greater than at the middle of the web.

Small pieces of the rare mineral kornerupine have been recovered from samples of Ceylon gem gravel, an occurrence not hitherto reported. Optical data for these specimens are given by B. W. Anderson and C. J. Payne.

Blue Stassfurt halite has been found by J. N. Friend and J. P. Allchin to contain gold which, if in colloidal condition, would be ample to cause the observed colour. It is suggested that the colours of various rocksalts may be connected with their gold contents.

RESEARCH ITEMS

Coloured Families in Liverpool

AN investigation undertaken under the auspices of the Liverpool Association for the Welfare of Coloured People into the economic status of 225 coloured families, supplements an investigation made some ten years ago, while reflecting changes in conditions which have taken place in that period ("The Economic Status of Coloured Families in the Port of Liverpool". The University Press of Liverpool, 1939. Pp. 23. 1*s*. net) The investigation was organized and directed by D. Caradog Jones, the material collected and analysed by Kathleen Johnstone of the Department of Social Science in the University of Liverpool. The coloured families investigated belonged to the class of those who had made "domicile of choice", and were known to have been insured under the Unemployment Insurance Acts. The bulk, but not all, of the men were West African in origin. Only one had been in the country for less than five years, while the largest proportion, 100, had been here for more than twenty and less than thirty years. The investigation in the main was confined to householders. Of the families visited, 201 had a married man as head, 2 with a widower, 3 with a single man, and 19 with a widow as head. Of the 206 male heads, 4 were old age pensioners or invalids; of the remainder 149 were unemployed. There are relatively few of pensionable age. There is a high proportion between 45 and 65, with a low proportion between 21 and 45 years. The mean number of children per family is 2·6 as compared with white 4·8 During the last ten years a change for the worse in economic conditions has taken place. Of coloured only 40 per cent were in receipt of earnings as contrasted with 75 of a survey sample of white seamen, while 73 per cent of the coloured were in receipt of unemployment benefit as against 34 per cent white. In relation to the poverty line, the figures are as follow: more than 50 per cent above, coloured 14·4, white 48·5; within 10 per cent above or below, coloured 22·3, white 10·0; and 10 per cent to 33 per cent below, coloured 20·4, white 15·4

Marriage Customs among the Barolong, South Africa

THE Barolong belong to the western cluster of the Sotho group of the Bantu-speaking tribes of South Africa and are found mainly in British Bechuanaland. Their marriage customs have been studied by Z. K. Matthews on information collected in the course of two visits in 1935 and 1937 (*Africa*, 13, 1; 1940). Socially the Barolong are divided into four sections, named after sons of a former chief who died about 1760. A number of agencies of acculturation, especially missionary influence and administration, have been at work among them. Traditional forms of social grouping based on kinship, locality, age, occupation and rank persist among them, but are undergoing much change. The traditional marriage customs of the Tshidi Barolong attach a great deal of importance to the institution, which is regarded as a state which should not be lightly entered upon, not only in the interests of the individual, but also of their kinship groups, including both the living and the dead, as well as the welfare of the tribe in which they live. It is a sacred duty to one's family to marry in order to continue the line of descent. Much litigation is concerned with family law, and constantly directs the attention of members of the tribe to the importance of the institution of marriage. Marriage is also regarded as a means of cementing friendship between two groups. It is therefore not surprising to find that parents claim and exercise the right to control the marriages of their children, especially when it is a matter of the chief wife, whose children receive first preference in the matter of succession to property. The term 'parents' includes other kinsmen who have the right to advise, especially father's father and brothers and important paternal kinsmen, while the views of the maternal relatives must be taken into account, especially those of the mother's brother, as no serious step can be taken in the affairs of her sister's children unless he be consulted It must not be taken, however, that the wishes of the man or woman about to be married will be entirely ignored, or that an individual could be compelled to marry against his or her wishes

Nitrogen Excretion and Metamorphosis

THE generalization that ammonia, urea and uric acid excretion are characteristic of aquatic, amphibian and terrestrial life respectively has received support by the work of A. F. Munroe (*Biochem. J.*, 33, 1957; 1939) He finds that a rapid change-over from ammonia to urea excretion occurs in the tadpole during the metamorphic stage of development, and this is also accompanied by a large increase in liver arginase. The initiation of the change is coincident with the period when the gills are shrivelling and the forelimbs are just piercing the gill coverings and thus giving rise to a functionally active terrestrial animal. He considers that liberation of thyroid substance, the stimulus for metamorphic change, exerts a direct effect on nitrogen metabolism in the liver, and he intends to continue the experiments on axolotls fed with thyroid.

Wing Dimorphism in a Dipterous Insect

JEAN GUIBÉ has published a detailed study of the growth and biology of the fly *Apterina pedestris* Meig., belonging to the family Sphæroceridæ or Borboridæ (*Suppléments* (No. 26) au *Bulletin Biologique de France et de la Belgique*). The most important part of this memoir concerns his breeding experiments. The only known wild type of the insect is the micropterous form, which is widely distributed in the northern Palæarctic region. Three types have been bred out, and it is shown that their inheritance is along simple Mendelian lines. One type, the homozygous micropterous form, produces, *inter se*, its own and no other form. The heterozygous micropterous type produces its own and a macropterous type in approximately the proportion of 3 : 1; in one breeding experiment the progeny resulted in exactly that proportion, namely, 555 micropterous individuals and 185 of the macropterous

kind. By crossing heterozygous micropterous forms with macropterous forms, almost equal numbers of both resulted in the progeny. It is evident that micropterism is dominant and that macropterism is recessive. The author concludes that macropterism corresponds to a simple Mendelian mutation, but this idea seems contrary to Dollo's law, since it implies re-acquisition of the former fully winged state. Few biologists will dispute that the original ancestors were fully winged or macropterous at an earlier stage in evolution. It would, therefore, seem reasonable to dissent from the author and interpret the micropterous form as the mutant and the long-winged form as the persistent original type. A further point of great interest is displayed in the author's account of the morphological differences in the wings and venation of the homozygous and heterozygous short-winged forms

The Genus Streptocarpus

W. J. C. LAWRENCE has reviewed the origins and horticultural development of the genus Streptocarpus in a recent paper (*J. Roy. Hort Soc.*, **65**, Pt. 1, January 1940). Plants of this group, though now florally valuable in many parts of the world, have been introduced to cultivation from South Africa, where they are concentrated on the Drakensberg Mountains. Stemless species which comprise the section Eu-Streptocarpus vary from the single-leaved forms, which are found mainly in the north, to the rosette kinds, which occur most commonly in the south. Intermediate forms appear in the middle of the Drakensberg range, and since all species of Streptocarpus have the same number of chromosomes, and many readily hybridize, it would seem that they are variants from some common stock. Mr. Lawrence then shows the effect of this variation upon the production of the beautiful garden hybrids now extant. A tetraploid form of a hybrid with *S. grandis* has occurred and has been named 'Merton Giant'. This geographical and genetical analysis of species in the making is a constructive replacement of the tendency to name each inconstant variable, so often favoured by the taxonomic 'splitter'.

Cirque Formation

THE *Bergschrund* hypothesis of cirque formation by a process of basal sapping of the rock has been more or less accepted in one form or another since it was suggested by W. D. Johnson. In recent years, however, W. V. Lewis has stressed the importance of meltwater in cirque formation, and he returns to this subject in an article in the *Geographical Review* of January. The evidence is obtained from cirques in Iceland, Spitsbergen and Switzerland. That meltwater occurs below the level of the *Bergschrund* and melts its way under the glacier seems to be established, but unless this water can refreeze it can have no plucking action on the rock wall. Various observations have shown that low winter temperatures do not penetrate very deep in glaciers, but in the want of contrary evidence Mr. Lewis suggests that freeze–thaw processes do take place at depths below the deepest *Bergschrund*. He points out that no temperatures have yet been taken at the head wall under a glacier, and that only a small amount of the meltwater need freeze in order to affect the rock wall, and finally that at great depths the temperatures must be fractionally below freezing point or the ice would melt under the pressure to which it is subjected. The weight of 36 feet of ice is equivalent to one atmosphere, so that the temperature within a glacier must fall at least at the rate of 0·1° C. for every 500 feet in order that the glacier may exist If local melting due to descending water releases the pressure at a point beneath a glacier, then the meltwater will rapidly fall in temperature, being chilled by the ice, and rapidly freeze. On re-application of the pressure any ice at 0° C. will melt again. Thus an alternation of freeze and thaw is possible.

Structure of the Pacific Basin

ACCORDING to B. Gutenberg (*Science*, **90**, 456–458; Nov. 17, 1939) the movements along the San Andreas fault in California occur in such a way that the eastern (continental) side moves south-eastward relative to the western (Pacific) side. Ch. Tsuboi has also stated that in Japan, along all faults, without exception the continental (western) side is moving southward relative to the Pacific side In addition, Bailey Willis contends that movements along the major fault in the Philippines occur in the same way, the continental side moving southward relative to the Pacific side. Gutenberg further states that the definite compression-dilatational patterns observed in all earthquakes without regard to their focal depth indicate that in all shocks the processes producing the waves are of the same type of faulting or shearing and cannot be due to a pure explosion or collapse in the interior of the earth Great earthquakes are common around the Pacific, and all deep focus earthquakes so far accurately determined have originated in the circum-Pacific area The boundary of the true Pacific basin is outlined by the earthquake epicentres. On the west side it follows the 'Andesite' line, which separates regions of different petrological and chemical composition. The foci of all earthquakes originating deeper than 200 miles have been found close to, and on the continental side of, this boundary. Different types of seismological evidence concur that continental surface layers appear to be missing over the greater part of the Pacific basin, but they are present in small thicknesses near Japan, New Zealand and California. There is also an area with 'continental' structure in the south-eastern part of the Pacific basin, though partially the Arctic basin appears to be of Pacific type.

Nuclear Isomerism in Zinc

IN the radioactive zinc obtained by bombarding zinc with deuterons, two β-emitters of half-lives about 57 min. and 14 hr. have been assigned to the isotope ^{69}Zn, which is therefore a case of nuclear isomerism. J. W. Kennedy, G. T. Seaborg and E. Segrè (*Phys. Rev.*, **56**, 1095) have now shown that the absorption properties of the β-rays from these two activities are the same. The β-spectra are presumably identical, and it is suggested that in each case the β-rays come from the 57-min. product, while the 14-hr. ^{69}Zn is a metastable excited state of the nucleus which decays to 57-min. ^{69}Zn with emission of a γ-ray. The γ-rays of energy 0·47 Mev. should therefore have no correspondence in time with the β-rays. This was verified by a coincidence counter arrangement which in a check experiment successfully detected the coincidences between the β- and γ-rays of thorium B. An attempt to separate the isomers chemically by taking advantage of the γ-ray recoil of the 57-min. product gave no positive result.

PROBLEMS OF EVACUATION

ASPECTS of evacuation problems are discussed in recent articles in the *Political Quarterly* and the *Quarterly Review*, which make a number of useful suggestions for their solution Reviewing the working and present position of the evacuation scheme in the *Political Quarterly*, Mr. A D K. Owen suggests that in Scotland uncertainty concerning the financial aspects of evacuation played a considerable part in deterring many people from going away or permitting their children to leave vulnerable areas He considers that more effective publicity, directed to the poorer sections of the population, relating to the financial implications of evacuation might have resulted in a more satisfactory response

While in the reception areas the situation is in many ways not unsatisfactory, it is difficult to see how the evacuation scheme can be successfully rebuilt in the absence of compulsory powers. Mr. Owen suggests that certain districts within the existing evacuation areas should be scheduled as specially dangerous all places, for example, within a certain distance of military or naval targets, shipbuilding yards, docks or important railway junctions—and children of school age prohibited from living in them save in very exceptional circumstances He also suggests that the law of school attendance should be amended so as to prevent parents from bringing their children home from reception areas without good reasons

The first measure would involve transferring all schools serving the prohibited districts to reception areas, and the second would make it possible to plan ahead with some assurance that the population for which plans are being made would not melt away before they matured. Schools in those parts of the evacuation areas which lie outside the prohibited districts should be opened as soon as they have been given reasonable protection, but a fresh approach made to parents in these areas to persuade them to allow their children to be evacuated or re-evacuated.

Capt. Frederic Evans, in the *Quarterly Review*, directs attention rather to measures which might be taken in the reception areas to organize new life for evacuees within the strange environment to which they have been taken. He emphasizes the importance of balancing out school accommodation and staffs, the development of specialized accommodation for difficult children, clinics, recreation and other purposes Holiday camps, youth hostels, and village halls could all offer important contributions, and if well organized might contribute to a closer wedding of the town to the country, with far-reaching and beneficial consequences to the whole nation.

Psychological and financial problems have to be faced and the careful planning of the medical services in the country is of special importance. Their staffing and provision pre-suppose a national service. Capt Evans urges that the considerable expenditure involved in the various social services required to solve these problems must be incurred or we may find the War has been fought in vain.

Dr. W A. Robson's article, "Evacuation, Town Planning and the War", is concerned with the wide issues which are opened up by the evacuation not merely of school children, but also of civil servants, business houses, etc., and the imperative need for some central control and planning if chaos is not to result from the indiscriminate location not merely of industry in the reception areas but also from the tremendous demand for premises and land by the civil and military authorities. The demands of the War Office and the Air Ministry for camps and aerodromes must be met without question or delay; but it would be the gravest mistake to permit all these new and necessary constructions arising from these as well as from civil needs, and also the consequences of evacuation, to take place in utter confusion or on the basis of *laissez-faire*, and with a complete disregard of the peace-time situation which will follow the War.

For this reason, and because our war-time exigencies are strangely consistent with socially desirable peace-time purposes, Dr. Robson views with such alarm the abandonment by the Government of the reports of the Royal Commission on the geographical distribution of the industrial population. Town and country planning should now acquire a new and more important status and be placed in the hands of a strong central department competent not only to deal with the special needs of the Service departments and the Government offices, but also to take over the long overdue task of directing the location of industry and formulating a national plan for the whole country.

AIR CONDITIONING

AN abstract of a paper on "Air Conditioning" read by W Chambers to the North Midland Section of the Students of the Institution of Electrical Engineers and published in the Institution's *Journal* of December gives a clear account of the objects to be attained by air-conditioning and of the methods by which it can be done.

The object is to maintain in a building an atmosphere that is most beneficial to the health of the occupants or which is most suitable to the process of manufacture carried on therein. To maintain these conditions, it is necessary to control the heat content or temperature, the purity, the moisture content (humidity) and the distribution of the air. A ventilating scheme in which the air is filtered, comfortable in temperature and adequate in volume, is sometimes considered entirely satisfactory, and little if any attention is paid to its moisture content, although the latter has a great effect upon the comfort of the human body.

In the case of public buildings where the number of occupants may be large and the lighting load large in comparison with the human content, the heat and emanations produced by the occupants have to be counteracted. The atmosphere should have a normal natural temperature and moisture content, with sufficient movement of the air to overcome stagnation.

To raise the temperature of the air in winter, it is only necessary to pass it over a hot surface, and most air heaters therefore consist of finned tubes which are steam-heated, and over which the air is forced to pass by means of centrifugal type fans. It must be remembered that heating lowers the relative humidity, owing to the fact that heated air is contained in a larger volume, but it still carries the same initial quantity of moisture as before heating took place. A pre-heated spray washer to maintain the humidity under control is often used.

In summer, in cooling the air the reverse applies, the relative humidity being increased, so that drying is necessary. This is done by exposing the air to cold surfaces or cold spray, whereby excess moisture is condensed and the air left saturated at a lower temperature. This can be done by mixing the air with air which has not been cooled.

In industrial neighbourhoods, it is necessary to extract from the air dust and grime particles. For this purpose filters are used, and the entire volume of air to be circulated is passed through them. Washers, viscous-type filters and throw-away type filters are used. The last type consists of a cheap fabric which may be cleaned by a vacuum cleaner nozzle, but it is more usual to dispense with them entirely and replace by new fabric. The efficiency of these filters is claimed to be greater than 99 per cent with removal of particles down to 1/30,000 in.

The comfort chart which the American Society of Heating and Ventilating Engineers has evolved shows that summer and winter conditions vary and that the average conditions are a temperature of 72° F. with a relative humidity of 50–60 per cent for summer and a temperature of 66° for winter with a similar humidity.

In an actual installation, the air is first passed through a filter and then tempered in a preheater; this has the effect of preventing the incoming air from being too cold and freezing the water in the washer. The science of air-conditioning is making great progress. The engineer of the future who aims at a thorough mastery of his subject must know physics, especially thermodynamics, and have also some knowledge of those branches of chemistry, medicine, biology, psychology and physiology connected with it.

ORIGIN OF THE CORPUS CALLOSUM

IN "Man's Place in Nature", T. H. Huxley expressed some astonishment at the abrupt appearance of a corpus callosum in placental mammals, suggesting that this phenomenon represents "the greatest leap anywhere made by Nature in her brainwork". Later on, between 1887 and 1895, this problem was studied by a number of anatomists, including Osborn, Zuckerkandl, Symington, Herrick and Elliot Smith, and several divergent opinions were expressed as to the phylogenetic origin of the commissure.

The evidence was clarified to a very considerable extent by the detailed work of Elliot Smith, who made full use of his opportunities in Australia for studying the comparative anatomy of monotreme and marsupial brains. Elliot Smith believed the corpus callosum to be a neomorph which is characteristic of eutherian mammals, and he suggested that its development was facilitated by the bilaminar formation of the fornix commissure which is developed in the marsupial brain. This observation also led him to infer the probability of a metatherian ancestry for placental mammals. Elliot Smith further directed attention to the distorting effect of the corpus callosum on the hippocampal formation, whereby the latter becomes stretched out into a thin atrophic layer of grey matter—the indusium. The latter, again, becomes continuous anteriorly with the hippocampal rudiment found in the precommissural area of the cerebral hemisphere. All these observations, and the conclusions which are to be drawn from them, have been accepted for many years by most comparative neurologists.

Quite recently, however, the whole question has been raised afresh by the contention of an Australian anatomist—Dr. A. A. Abbie[1]—that in its development the corpus callosum does not, after all, make use of a previous pathway already established by the fibres of the dorsal lamina of the fornix commissure, but is an entirely new commissural connexion formed along a zone of fusion between the two cerebral hemispheres which occurs *dorsal* to the hippocampus. According to Abbie's interpretation, the indusium is thus not the rudiment of the hippocampus at all, but a representative of an adjacent cortical area, the subiculum.

In a communication to NATURE[2] Abbie discussed the bearing of his conception of the origin of the corpus callosum on the ancestry of the Eutheria. It is interesting to note, however, that his conclusions do not differ essentially from those inferred by Elliot Smith on other grounds, for Abbie contends that the expansion of the neocortex and the consequent formation of a hippocampal fissure are the minimal requirements for the development of a corpus callosum, and this condition is first realized in the brain of monotremes and marsupials.

But it is important to note that Abbie's interpretation of the development of the corpus callosum has not passed unchallenged. In the current issue of the *Journal of Anatomy* another anatomist in Australia, Prof. F. Golby, has subjected the new thesis to a very critical examination[3]. His observations suggest that Abbie has been misled in his interpretation of microscopic sections by the distortion of the hippocampal formation at the subsplenial flexure, a distortion which has resulted in a reversal and displacement to a dorsal position of some of the fibres of the fornix commissure (forming the fornix superior), as well as in an illusory appearance in the position of the corpus callosum relative

to the hippocampus. Moreover, Goldby reproduces what appears to be a very convincing photomicrograph of a sagittal section of the brain of a rat which illustrates the precommissural hippocampal rudiment extending *dorsally* to the genu of the corpus callosum to become directly continuous with the indusium. Other observations of Goldby on the brain of a bat, Eptesicus, in which the disturbing influence of a subsplenial flexure is absent, also indicate that (as Elliot Smith maintained in his classical studies) the corpus callosum of placental mammals really does lie morphologically ventral to the hippocampus or its vestiges.

It remains to be seen whether Dr. Abbie's theory will find acceptance with other comparative neurologists. It may be suggested, in any event, that it will require to be supported by embryological evidence before it is found to be acceptable

[1] "The Origin of the Corpus Callosum", *J. Comp. Neurol*, 70, 9 (1939).
[2] "The Ancestors of the Eutheria", NATURE, 144, 523 (1939).
[3] "On the Relative Position of the Hippocampus and the Corpus Callosum in Placental Mammals". *J. Anat.*, 74, 227 (1940).

A ROMAN TOWN IN EAST YORKSHIRE

THE completion of five seasons excavation in the Bozzes Field, at Brough, East Yorkshire, affords an opportunity for a summary of the results of the investigation Although further excavation may necessitate modification of detail, it is considered that the examination of this Roman site has gone sufficiently far to secure the main outlines and conclusions as to its history which have been attempted by Mr Philip Corder and Rev Thomas Romans ("Excavations at the Roman Town at Brough, 1937", *Hull Museum Publications*, No 206; 1939).

Although the site lies within the northern military area and is on a route that was of great strategic importance during the early wars against the Brigantes, its occupation throughout its history, except for a brief period in the first century, was of a civil character. The Parisii of the wolds, in whose territory it was situated, were village dwellers, and no hill-top fort or town is known in the part of Yorkshire which they inhabited. Petuaria, as it is now known the town was called, eventually became the tribal capital and a walled town with Romanized institutions, but in size it never exceeded twelve acres

Little is known of the life of the Parisii before the Roman conquest, but a settlement has recently come to light at North Ferriby on the north bank of the Humber, placed conveniently on the pre-Roman route across the Humber and at the same time well situated for overseas trade with the Belgae of the Continent, for which evidence is afforded by Samian ware, *terra nigrea* and butt beakers found side by side with native vessels. Occupation, apparently, closes in the middle of the first century, at about the time of, or soon after, the establishment of the Ninth Legion at Lincoln in A D. 47 and the construction of Ermine Street. North Ferriby was then abandoned and the inhabitants, moving about three miles up the river, founded Petuaria at the point where Ermine Street crosses the Humber.

The phases of occupation may be summarized in brief as follows: The original settlement, little more than a kraal of native huts, without defences or regular plan, was swept away and the sites of the huts levelled to make way for the first Roman town in the opening years of the second century. This town also was without defences For a period after A.D. 71 a semi-permanent military base camp existed north of the settlement, which was abandoned after the construction of a great permanent fort farther north at Malton. In the reign of Trajan at the turn of the century grandiose plans were initiated for rebuilding the whole town in stone in Roman fashion. Massive foundations were laid and good roads made for the first time. These plans were never carried to completion

The reason for the interruption, which appears also at Malton, is unknown. Early in the reign of Hadrian, building was resumed, attention being directed first to the defences, for which the earlier plan had made no provision These defences are contemporary with Hadrian's Wall. The earliest buildings in stone within the town now appear, but their construction is poor and suggests haste. Thirty or forty years later much building activity is evident. In the reign of Antoninus Pius the defences, in which ramparts of turf had been employed, were entirely reconstructed in stone, a massive wall revetment being constructed in front of a rampart of red clay incorporating the earlier turf bank. The Antonine period marks the hey-day of Petuaria, and small though it was, it must have been a centre of Roman culture.

Throughout the third century town life in Britain declined, while large estates and farms flourished. Petuaria shared the general fate. No complete building can be ascribed to this century, though coins and pottery attest a continued occupation It shared also, however, in the attempt to revive town life in the fourth century under Constantius Chlorus. The town walls received massive rectangular towers, 25 feet wide and 10 feet deep. Within the town old buildings were reconditioned and new ones constructed. The attempt to put new life into the town failed here as elsewhere and beyond a few minor alterations to existing structures no building within the town can be attributed to a later date than the beginning of the fourth century. The coin list dwindles and ends with single coins of Gratian and Magnus Maximus, while late fourth century pottery of the period of the coastal signal stations occurs only sparsely. It is impossible to resist the conclusion that the life of Petuaria had already shrunk to insignificance at the time when the farms of the wolds were still prosperous.

Evidence of the status of Petuaria is afforded by an inscribed stone set up in the reign of Antoninus Pius by M. Ulpius Januarius, *aedile* of the *vicus*, to commemorate work done at his own expense in connexion with a theatre. Normally the *vicus* was unimportant and the business of its council parochial. The existence of an *aedile* at Petuaria implies the dignity of a self-governing *civitas* with full jurisdiction over all the *vici* in its territory. This in conjunction with other evidence would go to show that Petuaria had now become the seat of cantonal authority.

MECHANISM OF DRUG ACTIVITY

"HOW DO DRUGS ACT ?" was the subject of an address delivered by Sir Walter Langdon-Brown to an evening meeting of the Pharmaceutical Society on February 13 He classified the principal ways in which drugs act thus: (1) they increase or diminish the effects of stimuli reaching the cell from without, (2) they modify the chemical changes occurring within the cell itself, (3) they may themselves be so altered in chemical constitution by the cell as to be capable of fresh activity, yet with diminished toxicity He illustrated each of these methods by examples, some of the best illustrations of the first group from hormones, of the second from vitamins, and of the third from chemotherapy

It was little realized at the beginning of this century that a new era had dawned when Langley showed that the effect of adrenaline on any part was the same as if the sympathetic nerve to it had been stimulated; it merely seemed an interesting example of a chemical substance imitating a nervous stimulus. But it was much more important than that; although adrenaline has no effect on a structure which has never received a sympathetic innervation, Elliott found that cutting off that innervation did not abolish the effect of adrenaline on a structure which had once possessed it On the contrary, its effect was actually increased. For this reason both Langley and Elliott independently put forward the theory of a receptive substance beyond the nerve ending, on which the drug acted. Sympathetic stimulation has been found to produce adrenaline at the nerve endings; this is in addition to the adrenaline always stored up in the medulla of the adrenal gland which can be drawn upon as an emergency ration when there is a sudden demand for widespread action of the sympathetic for purposes of defence. Other illustrations were given showing how the normal transmission of the nervous stimulus is effected and the ways in which it may be interfered with or assisted by certain drugs

Sir Walter next gave some examples of the way in which drugs may act by modifying the chemical changes within the cell itself; he started by discussing some of the activities of thyroid extract, the quickening effect of which on metabolism has been described as the draught to a fire.

Other observations on drugs and oxidation processes were followed by extensive references to vitamin C (ascorbic acid), which is now so widely used as a drug As a strong reducing agent, it acts by balancing oxidation and reduction changes in the cell. Much study, said Sir Walter, has been recently directed to vague ill-health, short of that necessary to induce scurvy, due to lack of vitamin C. He gave an example which showed clearly that a specific case of vague ill-health was due to dietetic deficiency, and the material ascorbic acid was ready to hand to re-establish healthy oxidation and reduction changes within the cell

Chemotherapy illustrates the third group, the alteration of a drug by the cell so that it assumes fresh activity yet with diminished toxicity Sir Walter said that the treatment of any malady with a chemical agent of known composition may be included, strictly speaking, in the term chemotherapy, although it is almost universally limited to the treatment of parasitic diseases by chemical disinfection or control of the causative agent without producing marked toxic effect on its patient. The specific effects of drugs such as emetine in amœbic dysentery and arsphenamine in syphilis depends upon their chemical interactions with some constituent of the living cell.

MILK AND NUTRITION

A FULL account of a large-scale trial of the effects of giving various milk supplements to children at school is given in the final report of the Milk Nutrition Committee ("Milk and Nutrition". Part 4. National Institute for Research in Dairying, Shinfield, Reading. 2*s*. post paid) The researches of the Committee have been undertaken to compare the nutritive values of raw and of pasteurized milk. In the present report, results are given of tests upon school children of the growth and health-promoting properties of supplements of ⅓ or ⅔ pint of milk—amounts the same as those which figure in the Milk-in-Schools Scheme of the Ministry of Health.

Some eight thousand children from five different areas were divided at random into four groups, to receive, over one year, a daily ration at school of (1) biscuits; (2) ⅓ pint of pasteurized milk; (3) ⅔ pint of pasteurized milk; and (4) ⅔ pint of raw milk. The children were periodically examined, measurements being made of their physique together with assessments of their state of nutrition, intellectual ability, and *other features* such as posture and complexion.

The general trend of the figures obtained, set out in a number of tables, shows that the children given milk supplements increased in height, chest-circumference, and strength of pull to a greater extent than those receiving biscuits, and also improved more in their general state of nutrition and in their teachers' assessment of their ability. In addition, those on the larger milk supplement usually showed an improvement above those on the smaller, while there was no consistent difference between those on similar supplements of raw and of pasteurized milk. The advantages accruing to the milk-drinkers compared with the biscuit-eaters were small, though uniform and significant, amounting to less than $\frac{1}{10}$ in. in height and $\frac{1}{2}$–1 lb. in weight over the whole year during which the experiment was in progress. There was, unfortunately, no means of control over the home diet, and it is therefore possible that some given biscuits may have received additional milk at home, while milk-drinkers may have had extra biscuits.

A summary of the previously reported results of laboratory experiments on animals and feeding trials on calves is also given in this report.

SEVENTY YEARS AGO

NATURE, vol. 1, February 17, 1870

Measurement of Geological Time

THE first of two articles by A. Russel Wallace on this subject appears "Modern geological research has rendered it almost certain that the same causes which produced the various formations with their embedded fossils have continued to act down to the present day" This, Wallace points out, should make it possible to estimate the time represented by the whole series of formations, but the changes observed are too minute and too imperfect for such an estimate to be of value. The gaps in the record might be filled from observation of the changes of animal and plant life presented by each formation. "To measure geological time, therefore, all we require is a trustworthy unit for the change of species: but this is exactly what we have not yet been able to get; for the whole length of the historical period has not produced the slightest perceptible change in any living thing in a state of nature."

Wallace then gives a summary of astronomical evidence on the subject, referring in considerable detail to Croll's calculation of the eccentricity of the earth's orbit and the precession of the equinoxes in relation to the production of climatic changes. "Mr Croll considers astronomical causes to be the most important and effective agents in modifying climate while Sir Charles Lyell maintains that the distribution of land and water, with their action on each other by influencing marine and aerial currents, are of preponderating importance"

The Newall Telescope

"The 25-inch Equatorial Telescope, commenced several years ago by T Cooke and Sons, of York, for R S Newall, Esq, of Gateshead, is now so far completed that it has been removed from the works at York into its observatory in Mr Newall's grounds at Fern Deal The completion of a telescope with an object glass of 25 inches aperture marks an epoch in astronomy, and its completion in England again places us in the front rank in the matter of the optical art."

The tube of the instrument was 32 ft. long, and cigar-shaped; it was constructed of steel plates riveted together; focal length of lens, 29 ft. A full-page wood-cut of the instrument was printed.

PROFESSOR LIEBIG disputes Pasteur's view that the decomposition of sugar in fermentation depends on the development and multiplication of yeast-cells and that fermentation generally is only a phenomenon accompanying the vital process of yeast. He expresses the opinion that Pasteur's researches have not explained fermentation; but have only made known another phenomenon—the development of yeast -which equally requires explanation.

The *Lancet*, in speaking of the arrangements of hospitals, instances, as much needing reform, the system of grouping together indiscriminately in medical words, cases of various affections, in an atmosphere which may be destructive to some patients while it is suitable to others. Thus we may find lying side by side a case of bronchitis and one of fever; a patient with phthisis and another with gangrene of the lung.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or *before the dates mentioned*:

HEADMASTER of the Technical School, Oldbury—The Director of Education, County Education Office, County Buildings, Worcester (February 21)

BOROUGH ENGINEER AND SURVEYOR, BUILDINGS SURVEYOR and SURVEYOR TO THE LOCAL EDUCATION AUTHORITY—The Town Clerk, Town Hall, Eastbourne (February 29)

HEADMASTER at the Queen Mary's (Boys) School, Basingstoke—*The County Education Officer, The Castle, Winchester (March 1).*

PROFESSOR OF CHEMISTRY—The Registrar, University of Allahabad, Allahabad, India (March 31).

PROFESSOR OF PHYSICS—The Registrar, University of Allahabad, Allahabad, India (March 31).

ENTOMOLOGIST to the South African Sugar Association—The Director, Sugar Experiment Station, Mount Edgecombe, Natal, South Africa

TEMPORARY METEOROLOGICAL ASSISTANTS (*Male*) in the Meteorological Office—The Under-Secretary of State, S.2 B (Met), Department Q A. Air Ministry, Adastral House, Kingsway, W C.2.

ENGINEER for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S W.1 (quoting M/9113)

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W 1 (quoting M/9114)

SUPERINTENDENT ENGINEER *to the South Wellan Internal Drainage* Board—Calthrop and Leopold Harvey, Clerks to the Board, Solicitors, Spalding.

MINERALOGIST OR GEO-CHEMIST—The Director of Research, British Pottery Research Association, Queen's Road, Penkhull, Stoke-on-Trent

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research Report of the Food Investigation Board for the Year 1938 Pp. v+277. (London, H M. Stationery Office) 4s 6d net [291

Ministry of Health Memorandum on Scabies (Memo 229 Med.) Pp. 8 2d net Memorandum on the Louse and how to deal with it. (Memo 230 Med) Pp 12 2d net (London, H.M. Stationery Office) [22

Other Countries

Journal of the Indian Institute of Science, Vol. 22A, Part 21. Investigations on the Nature of Additions of Aliphatic Diazo-Compounds to Conjugated Double Bonded Systems, Action of Diazomethane and Ethyl Diazo Acetate upon Cyclopenta- and Cyclohexa-Dienes and their Derivatives By P. C Guha and G. D. Hazra. Pp. 263-274 1 rupee. Vol. 22A, Part 22. Synthetical Investigations in the Thujane Series, Part 9 A New Method of Synthesis of Umbellulonic Acid, by P C Guha and M. S Muthanna. Part 10: Experiments on a Total Synthesis of Thujone, Synthesis of an Isomer of α-Thujadicarboxylic Acid (1-*iso*propyl-1-carboxy-*cyclo*propane-3-acetic acid), by P C Guha and M S Muthanna. Part 11. Synthesis of an Isomer of α-Thujadicarboxylic Acid (1-*iso*butyl-*cyclo*propane-1 2-dicarboxylic acid), by P C Guha and M S Nande. Pp 275-286. 1 rupee. Vol 22A, Part 23: Reactions of Chromates at High Temperatures, Part 11: Structures of Chromium Chromates By D S. Datar and S K K. Jatkar. Pp. 287 308 1.8 rupees. Vol. 22A, Part 24 Reactions of Chromates at High Temperatures, Part 12 Magnetic Properties of Chromium Chromates. By D S. Datar and S K. K. Jatkar. Pp 309-316 12 annas Vol 22A, Part 25 Synthetical Experiments in the Pinane Group, Part 6 Further Attempts to Synthesise Pinonic Acid, Nopinone and Verbenone, by P C. Guha and P. I. Narasimha Rao; Part 7. Total Synthesis of Verbenone, a New Total Synthesis of α and β-Pinenes, by P. C. Guha and P. I. Narasimha Rao. Pp. 317-330. 1.2 rupees Vol 22A, Part 26: Activation and Clarifying Properties of Fuller's Earth, Part 6 Adsorption of Colouring Matter by Fuller's Earth in Decolorisation of Oils. By B. S. Kulkarni and S K K. Jatkar. Pp 331-340. 14 annas. (Bangalore Indian Institute of Science.) [301

Ministry of Public Health, Egypt The Research Institute and the Endemic Diseases Hospital Fifth Annual Report, 1935 Pp. x+65. (Cairo Government Press.) [12

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1939. (Publication 3552.) Pp. ix+139 (Washington, D C.: Government Printing Office.) 20 cents. [12

Catalogues

Catalogue of Optical Projection Apparatus. Part 3. The 'Newton' and 'Wigmore' British Epidiascopes. Pp. 28. (London: Newton and Co.)

Epidemic Influenza Virus Suspension I.V.S. (B.D.H.). Pp. 6. (London: The British Drug Houses, Ltd.)

Natural History: Insecta Varia. (List No. 4.) Pp. 40. (Den Haag: Antiquariaat Junk.)

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SCIENTIFIC MANAGEMENT IN ADMINISTRATION

IN the reviews of the progress of the War which have been given from time to time by the Prime Minister in the House of Commons, the preliminary testing of many of the plans drawn up for the organization of the nation in time of war has been revealed In these reviews, however, the actions of the armed forces or diplomatic matters have figured largely, and the home front as a whole has scarcely received the attention it merits. Particular aspects have been noticed, but the balanced and critical view of the whole economic effort of the nation, which is one of the main points in the argument for a Ministry of Economic Affairs, has been lacking

Accordingly a broadsheet on the home front issued by Political and Economic Planning (P E P) a few weeks ago is the more welcome for the careful survey of the position and its constructive criticism of matters on which Government spokesmen have said little or nothing. The first of the subjects reviewed in this broadsheet, that of the higher machinery of Government—the functions of the Supreme War Council and the War Cabinet—has also been touched upon in two admirable articles by Mr. Hugh Quigley and Mr. L. Urwick in successive numbers of *Industry Illustrated*.

The P E P broadsheet, reviewing the establishment of five new ministries for war purposes and the vast new functions of three other departments, points out that the Cabinet secretariat remains the only body concerned with co-ordination over the whole field. While the appointment of Lord Stamp as adviser to a Cabinet Committee on Economic Co-ordination shows a recognition of the importance of planning an economic policy on a much wider basis, the new office in its present form does not constitute an Economic General Staff Moreover, the development of regionalism in civil defence holds immense implications for a possible peace-time reorganization of our administrative system.

Mr Quigley's and Mr Urwick's articles make interesting comment on the question put by P E P, whether the Civil Service can meet the greatest demands made on it since it assumed its present form, and adapt itself to the new conditions with their primary call for decisions and planning. Mr. Quigley, emphasizing the importance of the efficient conduct of industry and of fitting the needs of war to an industrial machine which is allowed to develop normally and with the minimum interruption, makes the point that regulations tend to conceal the need for initiative and bold planning, when in truth more efficient management is needed

No country appears to have made any serious effort to determine what are good and valuable industrial products in a period of war and what are bad and non-essential. Such knowledge, however, is basic for the efficient use of a country's industrial resources, and this kind of assessment requires the experience and knowledge of those in control of industry. Accordingly, Mr. Quigley urges the importance of bringing management into consultation to ensure the maintenance of the important volume of normal production, and to determine the limits beyond which any strain on industry or any further loss of its man-power would be a source of dangerous weakness.

Mr. Urwick, while endorsing Mr. Quigley's argument as to the support which industry and management could render in maintaining the economic life of Great Britain in a planned and ordered relation to the whole national effort, lays his main

stress on the value of the principles and practice of scientific management in solving a whole series of difficulties now facing civil, military or naval authorities. Little progress has yet been made in the application of such principles and practices to the task of government, and Mr Urwick indicates two directions in which scientific management could give important assistance The first of these concerns ministerial co-ordination At the very top, the British Government affords an example of infringement of the vital principle of span of control, according to which no man can co-ordinate effectively the work of more than five subordinates whose work interlocks He urges that a true War Cabinet of half a dozen senior ministers without departmental responsibilities, giving continuous attention to policy and each responsible for co-ordinating a group of departments dealing with some special aspect of the national effort, is a necessity for the effective conduct of the War. Existing arrangements are technically faulty and therefore fundamentally unworkable.

Mr Urwick's second suggestion, concerning the assistance which scientific management could give in the training and control of clerical staff in the Army, is illustrative of a number of directions in which the application of modern management principles could be of service in fields where administration generally is probably as efficient or more efficient than in industry. The importance of utilizing such services grows as the field over which control becomes essential is extended, and as the checks on autocracy are weakened through the suspension of municipal or parliamentary elections, or the disappearance of local initiative and radical modification of the whole basis of local government

To neglect such matters is to court disaster, or at least to imperil the very work upon which we depend for the sustained effort and sacrifices demanded in a protracted struggle Mistakes have already been made, as in the indefensible commandeering of schools and hotels, which have more seriously damaged the credit of the Government than its spokesmen care to admit. The absence of reform or evidence of contrition in such matters as these has consequences which are not the less serious because they are not immediate, and they may easily sap confidence at the very moment it is most essential.

Criticism in Great Britain of the control already exercised is indeed directed, not against the principle of control, but against the way in which some controls have been effected. The authors of imperfect plans—and the bunglers of good plans—cannot claim immunity from constructive criticism merely because we are at war On the contrary, the onus lies on those who designed or are administering the controls to say where criticism is not justified. That such criticism has frequently been justified by its results and led to the withdrawal or modification of such schemes as those for the control of fish marketing, war risks insurance, or the Ministry of Information, is one of the most hopeful signs that the Government is not unresponsive to public opinion or unmindful of the necessity of safeguarding the liberty of the subject and inviting the co-operation of the public.

The most serious effect of such errors of judgment as the commandeering of hotels and schools is not the individual hardships involved, or the general irritation at stupid blundering, but the lack of confidence engendered in the smooth working of the vast national plans as a whole The P E P broadsheet does not, with all its constructive criticism, suggest that there is anything essentially wrong with the principles of our war-time planning, though it indicates details in which criticism and public co-operation might improve matters It does indicate, however, the existence of conflicting orders and a lack of co-ordinating authority, and the necessity of facing a drastic revision of traditional policies.

These points are specially stressed in relation to finance, to the planning of priorities, of man-power, agricultural policy and food control All these, moreover, are clearly interlocked. In regard to finance, the war budget relies almost completely on the old system of taxation. The vital issue is to decide how much of the national income can be taken for war purposes, or what combination of price control, inflation, taxation and borrowing should be used for diverting enough of the national income from civil to military needs. One of the most difficult problems of war finance is how to control the dislocating effect of a vast increase in Government expenditure and the consequent widespread distribution of purchasing power at a time when a large proportion of the country's resources—labour, capital equipment and raw materials—is diverted from the provision of goods for current consumption to war purposes. The suggestion recently put forward by Mr. J. M. Keynes for dealing with this question of control of consumption by compulsory saving is a departure from the traditional policy which deserves careful

examination, although good results are already being obtained by voluntary effort.

Such questions of finance are linked inextricably with the maintenance of export trade, and the question of exports and the distribution of export effort between the old heavy industries already fully engaged with war work and the newer light industries It affects questions of prices, wages and profiteering and the planning of priorities. Clearly the Central Priorities Department should be used to plan the whole economic output of Great Britain and not just the supplies of the defence services. The needs of the civil population and of the export trades must also be considered and balanced against each other, if the most efficient use of available resources is to be secured.

Planning the utilization of Great Britain's resources of man-power to the best advantage is the function of the Ministry of Labour in consultation with the Labour Sub-committee of the Ministerial Priorities Committee. There is already evidence that lessons have been learned from the blunders of twenty-five years ago, and the compilation of the National Register should provide information for planning man-power much more comprehensively than before It is doubtful, however, whether the true value of the Register in the scientific organization of a civilized community is yet realized. The Central Register has already proved its usefulness in placing certain classes of scientific workers where their services are most urgently needed; but it should be remembered that the whole register is experimental, and that experience is likely to suggest many improvements and extensions.

Complex problems of labour are bound to arise not merely in the munitions industry but also in agriculture and through the relations between rail and road transport, where fundamental reconsideration of the positions of both industries is urgently required. In agriculture, itself so closely linked with the question of food supply and rationing, a general clarification of aims is urgently required Modern industrial, economic and scientific technique finds little reflection in much of the farming still practised; the pooling of all available knowledge in the service of war-time efficiency on the farm is as important as pooling labour, machinery, horses or even the land where the units are now too small to operate economically.

If, however, control and rationing are to be accepted with good grace, there must be confidence that adequate co-ordination of the national effort exists, and that steps have been taken to secure the scientific and impartial utilization of the full resources of the nation in the one purpose that counts. Rationing, whether of petrol or food or other commodities, will be accepted without demur so long as the private user does not feel that he is deprived of supplies for officials to waste Scientific workers, who have their own contribution to make in so many widely different fields, should not therefore be unmindful of this supreme need for insisting that the fullest use is made of the methods and principles which scientific management puts into our hands, for securing the due co-ordination and efficient operation of any enterprise in the fulfilment of its purposes, whether they be those of a private business or of a nation at war.

THE ORIGIN OF LIFE

Life's Beginning on the Earth
By Prof. R. Beutner. Pp. x + 222. (London: Chapman and Hall, Ltd., 1939.) 12*s*. 6*d*. net.

THE "Manager of the Performance" as Prof. Beutner invites his readers to regard him, apparently supported by the Provost, Dean and staff of his Institute, stands on the stage before the curtains are drawn for the film. The technique is useful in that exact references to literature are unnecessary and concentration of eye and brain is secured. There is also no index and the mind is not usually disturbed by references to the sources from which the pictures are derived. These lapses make the film less useful to scientific men, while causing less strain on the commencing students of science and medicine for whom it is perhaps primarily intended. To these, all comparisons between the reactions of living and non-living matter cannot but present helpful analogies, which may well prove of great value to medicine, as suggested in the epilogue. The subject, however, has a wider appeal, for evidently certain of its sides have been the author's research life for many years. It deserves more than a passing reference.

As a practical presentation we suggest that the manager has reversed the order of the pictures of

his film We would feel greater happiness in leading off with the reactions of the oil drop to its environment in comparison with Amœba, because the layman learns the reactions called 'living' in connexion with tangible analogies that he can the better understand. Beutner, following on the pioneer work of Jennings, studied here, using Telkes drops made from fresh brain material which, of course, is rich in the lipoid lecithin These are more complex than the drops of vegetable oils, but their method of preparation precludes the idea that they contain living matter Experimentally they present many varieties of pseudopodia and of movement such as are found in the naked Protozoa[1], but there is never any increase of the mass They exhibit respiration which in places lowers surface tension The drops formed from the brain of an exhausted animal no longer show the mass of tiny fibres usual to those from the healthy animal Poisons such as strychnine inhibit respiration and stop all movement, while, if free access of air is prevented, suffocation follows No reactions can be recorded in pure water, for the drop is starved. The author next proceeds to a set of analogies in the phenomena of electrical actions in the nerve impulse, Lillie's researches freely quoted. He has studied the electric organs of fish and made artificial fat batteries which yield by analogy helpful results His experiments suggest to him that poisons *may* kill by interference with the electrical mechanism rather than by their reactions on enzymes.

We pass by the numerous analogies between the actions of living cells compared with those of artificial gelatin cells, the formation of semipermeable membranes and the magnitude of osmotic pressure. In this matter Traube's research (1860–70) can be read profitably by biologists even to-day, together with its subsequent development by Pfeffer Leduc's imitations of many living forms are well illustrated, these artificial osmotic structures that counterfeit plant-growths amazingly well. "Salt and water are a part of life itself."

The consideration of the unique nature of carbon and its compounds leads the reader to basal considerations The chemist, using elaborate technique, can make many carbon compounds that the organism produces with the greatest ease by means of enzymes or ferments The most widely known is chlorophyll, the utility of which requires no comment Usually any action necessitates the employment of several enzymes, so that the extraction of some in pure form has had no practical results. To this category perhaps belong the plant-formed vitamins, which in animals must be re-fed to the body continually to avoid disease. Then there are the hormones made inside the body and carried to where they have the highest activating influence, the best known being insulin. To-day, it is within our imagination to transform one of these bodies into a living body as, by radioactivity, elements can be transmuted. Naturally the search is for the smallest living matter and so we are led to the filtrable viruses[2], the disease-producing effects of which are well known. Their actions so closely simulate those of bacteria that life must be allowed to them From these, crystalline substances were obtained by Stanley in 1935 using tobacco-mosaic leaves, afterwards those of phlox and spinach These were repeatedly crystallized and found to produce the diseases at will, all facts being reasonably "explained on the assumption that the different virus proteins are in fact the different viruses". The problem for the chemist is to synthesize the enzyme and, this accomplished, to endow it with the property of self-regeneration On this basis an idea of the development of cells is possible, with all that this entails

We have omitted reference to the chapter devoted to "vital growth and crystallization" in which, as living matter is made up of diminutive crystals, the building forces are deemed to be similar in the living and non-living world This leads to Beutner's review of Oparin's work "The Origin of Life", 1938. Condensations of nebular matter from the sun are assumed to produce planets[3], first carbon, then a series of metals, finally water, leaving the atmosphere as we know it , this is in contrast to the planet Jupiter with its methane-ammonia surround. Oparin suggests that organic substances were present in the early ocean as colloidal solutions. The interaction of various colloids caused segregation resembling crystallization, these "coazervates" gradually developing into living organisms. In this process enzymes must have formed in them so that they were able to assimilate substances from their environment. In contrast, Beutner maintains that self-regenerating enzymes formed by electric discharges were the earliest appearance of life—and it necessarily follows that such enzymes may have been formed at all ages in the world's history

To summarize : research has shown developments of non-living matter strikingly resembling certain features of life, and the further development of such researches may at any moment illuminate the cosmic miracle by which life can only be supposed to have been produced either on this or any other world. J. STANLEY GARDINER.

[1] This is perhaps due to liquid crystallisation, a process seen in the central filaments of the Heliozoa. The surface covering of Amœba consists of protein and lipoid molecules so that the pseudopodia must be quite different

[2] Their size is that of the molecule of hæmocyanin.

[3] This view is ascribed to "J. Jeans", who will scarcely desire to be termed "a Russian astronomer". Oparin apparently was not acquainted with Stanley's researches, for they are not included in his bibliography.

SALT DEPOSITS

Steinsalz und Kalisalze: Geologie
Von Prof. Franz Lotz (Die Wichtigsten Lagerstätten der "Nicht-Erze", Band 3, Teil 1.) Pp. xxvii+936 (Berlin Gebruder Borntraeger, 1938) 84 gold marks.

SALT deposits are of surpassing interest from many and varied aspects The details of their depositional succession, their complexity and association, and the post-depositional changes which they have undergone provide a vast series of physico-chemical problems which have furnished material for the classic researches of van 't Hoff and a host of others They are of no less interest to the geologist, who examines in them the record of those rarer episodes in the earth's history when the customary sequence solid-to-solution was reversed Besides, salt, because of its great chemical and physical reactivity, is the most temperamental of rocks So soon as it is laid down it is liable to be dissolved, transported, modified by solutions from above or below, and this any number of times If it is involved in folding of the crust or tectonic events of any kind it reacts like no other rock; instead of folding as other rocks do, it flows, and under continued pressure it may become unstuck from its associates, penetrate higher levels of the crust in intrusive fashion as diapirs and salt plugs and may even flow out on the surface as salt glaciers Countless surprises are possible if salt deposits are members of a rock series the geological history of which is at all lively.

Lastly, natural salts form one of the most important raw materials of industry. Like other mineral deposits, they are not uniformly distributed among the nations of the earth. In time of war, therefore, certain minerals become "strategic"—as the Americans put it—and of major importance among the strategic minerals are the potash salts. Germany, by virtue of her geographical position in the centre of the dried-up shallow sea of the great salt-building period of the Permo-Trias, has almost a monopoly of potash salts; it should be added that with regard to practically all other strategic minerals her native resources are inconsiderable. It is fitting from the academic point of view that Prof. Franz Lotze, of the University of Berlin, *ein guter Kenner der Salzlagerstätten*, should provide a monograph on the rock-salt and potash salt deposits of the world. It is fitting, too, from many other aspects, that this monograph should now be available at this present time to certain interested, but non-German, parties.

The *Salzband* of this well-known series dealing with the non-metallic mineral deposits is to consist of two parts The first is the bulky volume under notice here and is concerned entirely with the geological relations of salt deposits. The second part, by Prof. Leonhardt, will provide an account of the mineralogy and petrography of natural salts, the physical chemistry of salt deposition is mentioned only incidentally in the geological part.

Every aspect of the geology of the deposits of sodium and potassium salts of the world is examined in complete detail. The book is divided into two sections. In the first a general geological account is given; in the second special descriptions of the world's salt occurrences are provided As a start, salt formation at the present day is dealt with, and here is included a good discussion of the origin of the salt in the sea. Halley, as early as 1715, suggested that this was derived from the weathering of the rocks of the continents and thus started a notion which is still current and which, indeed, has formed the basis of one method, now discredited, of estimating the age of the oceans. But the oceanic waters have a content of chlorine far greater than could have been provided by the weathering of primary rocks It is suggested that whilst the salt of the sea is all derived from primary sources, it has nevertheless arrived in the sea by two routes, the metals from primary igneous rocks, the non-metals from volcanic emanations—the two groups of components are separated by igneous processes but are reunited in sea-salts.

After describing the many types of salt deposits being formed at the present day, Lotze deals with the general geological principles of salt deposition in the past. The relation of salt formation to the great mountain-building periods, the southward migration of the salt-belts during the course of geological time and the origin of *thick* salt deposits are among the topics of interest discussed.

After an account of the secondary changes that salt deposits are liable to undergo so soon as they are laid down—a matter that will presumably be discussed in greater detail in Leonhardt's mineralogical part of the *Salzband*—there follows a full description of the almost fantastic tectonics of salt deposits. The various intrusive, unglued and rootless forms of salt bodies are related to the tectonic styles of the portions of the crust in which they

occur. Structural geologists will find here matter of absorbing interest The first section of this book, that dealing with the general geology of salt deposits, closes with some twenty-one pages of references

In the second or 'special part' of the volume, detailed descriptions of the salt occurrences of the world are given, the general arrangement being based upon a regional geological foundation. Special attention is directed to the salt deposits of Europe and North America in relation to the large-scale tectonics of these continents. During the War of 1914–18 the virtual monopoly in potash salts possessed by Germany had become forcibly realized by other nations, and consequently there has been, in the post-War period, a strenuous search for new supplies, especially in the United States and the U.S.S.R. Most of the results of these campaigns, especially the Russian, are not readily available, but still Lotze provides a considerable amount of information on non-German occurrences of potash salts He devotes most space—more than two hundred pages—to the consideration of the immensely important rock-salt and potash salt deposits of the Permo-Triassic basin of Middle Europe, which include the magnificent German potash salt fields and the not inconsiderable rock-salt deposits of the Trias in Great Britain The elucidation of the various depositional cycles of the German fields, of the facies changes in them and of the palæogeographical conclusions to be drawn therefrom is made particularly clear. Details of national production are not given; these may be found in the current statistical summaries, such as Roush's "Mineral Industry". This 'special part' of Lotze's volume concludes with nearly fifty pages of references.

Fortified with its bibliographical detail, an index of more than a hundred pages, 353 text-figures and numerous tables, this work provides a summary of all that is known about the geology of a group of rocks of outstanding scientific, economic and international importance

H. H. READ

THE AMERICAN OUTLOOK ON COTTON

Cotton
History, Species, Varieties, Morphology, Breeding, Culture, Diseases, Marketing and Uses. By Dr. Harry Bates Brown (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. xiii + 592 (New York and London. McGraw-Hill Book Co. Inc., 1938.) 30*s*

IN the enlarged second edition, as in the first, the merits and weaknesses of this book are equally evident It is a remarkable single-handed production giving the reader a wide view of every part of the cotton field, from the germ cell to the world crop of three million tons Taxonomy, physiology, agriculture, merchanting, spinning, weaving and statistics are all included. We know of no better comprehensive presentation, and the quality of the citations is such that it can be used as a book of reference.

Its weakness results from the fact that extreme specialization on such a versatile crop as cotton involves the specialist in contacts with every subject under the sun, and in many of these he must be, however unwillingly, a dilettante. Also, he must reside somewhere, and when that residence is in the country which produces half the world-crop of his subject, his presentation must be biased by a tendency to overlook the smaller contributors.

Now, from a cotton-grower's point of view, the United States is mainly a mass-producer of unspecialized raw material, under conditions which as expressed in terms of yield per acre, are also unspecialized Thus, while America must form the background to any book on cotton, the most advanced and informative work on cotton is nowadays to be found outside it, from countries where small crops present local difficulties, where specialized crops demand special care, or where, as in Lancashire, economic difficulties demand intensive study and research on the industrial end. This widespread area of information outside the United States of America has not been entirely neglected by the author, but it has not been adequately examined We doubt whether it could be searched and critically sifted single-handed, but the transactions provided by the Shirley Institute in the *Textile Institute Journal* would be expected to provide some of the references in the chapter on cotton-spinning. Similarly, while Egypt is growing her whole crop from pure-line seed under a system of routine seed-renewal, with a yield per acre which is three times that of the United States and a price per pound which is half as big again, some references to Egyptian publications of later date than contributions by the present reviewer published more than twenty-five years ago should surely be of interest.

Substantially our criticism condenses to the title. If this were "Cotton from the American Point of View", we could praise without reserve.

W. L. B.

SOCIAL STUDIES IN ENGINEERING

(1) Spanning Space
By Claude A. Claremont ("Science in Action" Series.) Pp 125 (London · Sir Isaac Pitman and Sons, Ltd , 1939.) 3s.

(2) The Development of Power
By Eugene C Wittick. Pp. xiv+164 (London · Cambridge University Press ; Chicago : University of Chicago Press, 1939) 5s net.

THESE two small books deal with engineering subjects in a popular way, and though their methods of treatment differ, there is a considerable measure of unity of plan to be observed in them

(1) The first volume is an English publication, one of the "Science in Action" series the purpose of which is to describe, in a readable way, interesting and important activities and the scientific principles underlying them. Here the object is to explain to the general reader the several types of bridges in use and the ideas and principles on which their designs were based The author, besides being an engineer, is co-principal of the Montessori Training College, London, and has dedicated his book to two small boys. He reasons out, in simple yet graphic language, the fundamental concepts in the design and construction of twelve different kinds of bridge One could wish that such a book were largely adopted by teachers The main subject is so familiar both to teacher and child. The historical notes and development, the properties of the materials suitable for each type, and the constructional details make up an impressive picture of purposeful adaptation which must convey a valuable lesson to a child's mind.

(2) In the second volume, the range of the subject is wider. It treats of the several sources of power and describes the machinery used to develop or transmit power in its different forms The historical notes provide a background which explains and adds interest to later developments This American publication is intended as a college text-book to stimulate the minds of students and to provide a source of information regarding the influence of this branch of engineering on social life. It may well be imagined that the Egyptian who had roughly devised a wheel which he could turn to raise water more easily than by buckets must have noticed that the flow of the river caused the wheel to turn. By combining the two functions he got a self-operating means of irrigation which left him free for other pressing work. The same simple impulses are at work to-day, though not so obviously, and if such books as these two were generally read and understood, the basic laws operating in our social life would be better appreciated

A COURSE OF PHYSICAL CHEMISTRY

Kurzes Lehrbuch der physikalischen Chemie
Von Prof. Dr. Karl Jellinek. Heft 1 . Grundprinzipien der physikalischen Chemie, Lehre von den reinen Stoffen und Mischungen von Nichtelektrolyten (Physikalisch-chemische Thermodynamik). Pp. xiv + 314. 8.50 fl Heft 2 : Elektrochemie Phasenlehre, Lehre von den Phasengrenzflaechen (Kolloidchemie), chemische Kinetik. Pp. xii + 292. 7.50 fl. (Deventer : N. V. Uitgevers-Maatschappij Æ. E. Kluwer, 1938, 1939.)

THESE are the first two of four parts of Prof. Jellinek's book, each part being independent. The first part deals with fundamental principles and their application to pure substances and mixtures of non-electrolytes.

The subjects fall under the two main headings of thermodynamics and kinetic theory, and in both cases the subject is fully and clearly treated, all mathematical requirements except the elements of the calculus being explained There are many worked examples, and this is a very good feature of the book. The diagrams are neat and instructive, although the lettering is sometimes rather small, and there are some useful tables of numerical data. The symbols are well chosen, but a list of them would have been useful. The subjects include Nernst's theorem, which is dealt with from the modern point of view of entropies, and activity as far as it concerns non-electrolytes.

In most cases, alternative proofs of thermodynamic formulæ are given, one based on a cyclic process and the other on the thermodynamic functions, so that the reasoning is always made perfectly clear.

The second part of the book treats of electrochemistry, phase rule, surface and colloid chemistry, and chemical kinetics. The section on electrochemistry deals with electrolytes (including

the modern theory of strong electrolytes), electrode potential and galvanic cells, and chemical equilibria with electrolytes (including indicators, heterogeneous equilibria, and fused salts) Although the Debye-Huckel equation is not actually deduced, it is very fully explained and illustrated by examples, and the idea of activity is introduced and used in a very complete and practical manner. The numerical examples frequently interpolated in the text make everything clear and intelligible, and there are many good figures.

The section on the phase rule deals only with one- and two-component systems but comprises well-chosen examples The treatment of reaction kinetics includes the recent theories of active molecules as well as the classical examples, and the treatment of heterogeneous kinetics is very full, including a discussion of overvoltage and passivity, also comprising modern work.

There is no doubt that this book is likely to prove extremely helpful to both students and teachers, since the author has spared no pains to make the subject clear, understandable, and modern. A good feature is the close relation which is always preserved between theory and practical methods, the latter being explained briefly but adequately If the remaining volumes of Prof Jellinek's treatise are as good as these, the complete work will be an excellent survey of modern physical chemistry which will be certain of a warm welcome The paper and printing are very good, but the number of small misprints is much larger than that included in the short list of errata.

OXFORD MEN OF SCIENCE

Early Science in Oxford

By R. T. Gunther Vol 11. Oxford Colleges and their Men of Science. Pp xvi+430+50 plates (Oxford: The Author, The Old Ashmolean, 1937) 30s

DR. GUNTHER must be praised for the enthusiasm and hard work which have led him in the period between the Wars to found a museum for the history of science in Oxford and to give to science eleven volumes of part of its history. Some of this work has not escaped criticism, but the reception of most of it has been good. The present work is one that deserves a friendly welcome and an accessible place in the libraries of men of science and especially of Oxford men. Dr. Gunther has worked at his task with great energy and purpose, amassing from many sources, many of them little known (unfortunately not listed here), a large amount of interesting information on the personalities, aims and achievements of Oxford men of the past. Dr Gunther happens to be more attracted to the antiquarian than to any other aspect of the past, to the biological sciences than to the physical, to instruments than to scientific ideas, to museums, perhaps, than to laboratories, and all he writes reflects the man. If we agree to accept Dr. Gunther as he is, and not to expect a cold, impartial historian, we shall have little to criticize and much to praise in this, his eleventh, volume.

The book begins with a survey of the whole subject in lecture form: the inaugural lecture given by the author in 1934 as first reader at Oxford in the history of science. Separate chapters, twenty-one in number, are then devoted to the colleges whose alumni in both the distant and recent pasts have made contributions to science. There is a final chapter on men like Robert Boyle who did scientific work in Oxford independent of the colleges, and there is a gather-up of material, not all of it relevant, in the form of seven appendixes

In the chapters on the colleges, the worthies of each are presented in turn, their scientific achievements briefly described, and often some odd or out-of-the-way piece of information added; sometimes a portrait is reproduced. 'Oxford man' is rightly interpreted widely, as anyone of scientific attainments who has been connected with a college, and not necessarily one who had been an undergraduate there. Thus, in the chapter on Merton College we are told of William Harvey, who was not originally an Oxford man, as well as of men like Sir Henry Savile and Grant Allen who were; Robert Hooke properly comes under Christ Church, although much of his best work was done at the Royal Society in London. If the embrace had been less catholic, Dr. Gunther would have had little to do, for in the far past the number of Oxford men, in the narrow sense of having been undergraduates there, who stayed on after taking their degrees to do great scientific work, could be counted on the fingers of one's hands.

In the descriptions, a little expansiveness on the author's part would occasionally not have been amiss. In the chapter on Oriel College, we are told of the mathematical work of Prof. Baden Powell. Dr. Gunther might have added that Powell, who was elected into the Royal Society

so long ago as 1829 and was old enough to have fought at Waterloo, was the father of the present Chief Scout. In the chapter on Christ Church, 'Dr. Tupper' is described simply as an inventor, a D.C.L. and an F.R.S. But he had these six welcome letters after his name before he was thirty-seven years of age, and he was the versifier whose christian name was Martin. Again, V. H. Veley, of University College, is mentioned as having shown that pure nitric acid has no action on copper, but nothing is said of the far greater work of H. B Dixon, of Balliol, and H B. Baker, of Christ Church There was, in fact, at one time in Oxford a school which appeared to set out to show that pure things do not do what it is commonly supposed they do do, one member showing that pure nitric acid does not etch copper, another that carbon will not burn in pure oxygen, a third that pure iron does not rust, and a fourth that pure ammonium chloride does not dissociate thermally. Possibly Dr Gunther would not regard these investigators as coming into the field of "Early Science"

As was to be expected, this book is well illustrated. The choice has been carefully made and the reproductions are numerous and very good. They include many little-known portraits of Oxford's scientific sons A. S. R

AMERICAN VEGETABLES

Vegetable Crops
By Prof. Homer C Thompson. (McGraw-Hill Publications in the Agricultural Sciences.) Third edition Pp. xi + 578. (New York and London: McGraw-Hill Book Co., Inc , 1939) 33*s*

THIS book is the third edition of a standard American text-book dealing with the production and marketing of vegetables. Particular attention is paid to vegetables cultivated in the eastern States, and all the subtropical products from limited areas of Florida and elsewhere are omitted

Nine years have elapsed since the previous edition, and opportunity is well taken to bring the text up to date, and to include consideration of recent research, carried out for the greater part at the Cornell Agricultural Experiment Station.

As in previous editions the earlier chapters deal with the principles and methods of cultivation, with soils, manures and fertilizers, and irrigation. A brief consideration of marketing and storage problems is included, but the major portion of the text is devoted to a systematic study of the commoner vegetables.

Although the underlying principles of cultivation do not differ from those laid down in most other countries, the very real differences between local climates and soil conditions, together with differences experienced in transport and marketing, overshadow these similarities. Further complications arise for English readers due to differences in nomenclature, to synonymy, and to different methods of varietal classification. An example or two must suffice: there is no entry in the index of haricot beans, a term applicable to certain varieties of dwarf French beans of which the young pods, but more especially the dried seeds, are so valuable; although the reader will find an alternative classification of beans according to their use, he will yet have to decide whether to include his haricot under snap beans (with edible pods) or dry shell beans Similarly the classification of cabbages, although based on sound morphological lines, would not be entirely suitable for all our English varieties

In regard to pests and diseases there are some of major importance in the States which fortunately are not yet with us, but our crops suffer from other pests and diseases which are of such little importance in America that they naturally receive brief attention in these pages; the pests of the potato illustrate this point.

The author includes the deficiency troubles due to a lack of boron, shown in cauliflowers by hollow stems and brown curds, in beet by black spotting, and shown by the brown heart of rutabaga, better known in Britain as swedes.

Although there are brief descriptions of the somewhat uncommon chayote (*Sechium edule*), and okra (*Hibiscus esculentus*) and martynia (as *Proboscidea Jussieudi* Keller) the author omits the yams (*Dioscorea sps.*), the Chinese artichoke (*Stachys tuberifera*), and the Peruvian oca (*Oxalis, crenata*) and other rarer vegetables.

A valuable feature of the book is the literature cited, comprising some five hundred titles, mostly of recent American work. The book appears in the well-known format of the series by the McGraw-Hill Publishing Co., and it is somewhat expensive.

The success of American and British growers in breeding and selecting varieties suitable for their own conditions tends to make this book of somewhat limited use to growers in another country, although its value to students, for whom it is written, is not thereby seriously impaired.

LIVE STOCK POLICY DURING WAR-TIME

By Dr. Charles Crowther,
Principal of the Harper Adams Agricultural College

SINCE the eighties of last century, the main effort of British agriculture has been steadily and increasingly diverted from crop growing to the production of live stock and live stock products. According to recent statistics these now account for about two thirds of the total value of the agricultural output of England and Wales, and an even higher fraction of the Scottish output This expansion of live stock production with a dwindling arable acreage has only been made possible by the import of feeding-stuffs, which has shown a corresponding rise to a level in recent years of about 7⅜ million tons per annum. This represents, according to Wright's estimates, in terms of 'starch equivalent' about 22 per cent of the total nutrients consumed by live stock in a normal year (1935), the balance of 78 per cent being obtained from home-produced fodders, roots and corn. In these terms of gross supply, the proportion of imports does not appear to be unreasonable ; but in terms of concentrated foods the balance assumes a very different aspect, since imports are entirely of this class and amount to more than twice the home-grown supply of concentrates. It is inevitable, therefore, that in times of crisis involving shipping difficulties the supply of imported feeding-stuffs, unless vast reserves have previously been accumulated, must rapidly become a serious problem for the live-stock industry, compelling some change of policy, more or less drastic, for the early stages, if not for the whole period, of the crisis.

The general lines along which such adaptation must take place were evolved by force of circumstances during the War of 1914-1918 . increase of home production of arable crops, utilization of household and other food waste, and rationing of available concentrated feeding-stuffs with priority to those classes of animals which either make more economical use of these concentrates or give a product that is of special importance in the national dietary In the present emergency, therefore, it has been possible from the outset to formulate the war-time policy for the production of live stock and live stock products along these lines, and with varying degrees of grace the broad principle of the policy appears to have been accepted by the industry.

The necessity for the 'speed the plough' and 'dig for victory' campaigns in the interests of the human consumer are obvious ; but both may also be made to contribute substantially to the home supplies of food for live stock, the former through the farm, and the latter through allotments and gardens A parallel increase must also be effected on our grasslands, where modern research has greatly extended the possibilities of improved management and utilization, and of conservation of surplus produce for winter use. No great expansion of the artificial drying of grass by private enterprise on farms is probable, but serious consideration should be given at once to the possibility of establishing a national grass-drying organization, for which a large nucleus of raw material would be available on aerodromes and other large areas from which the grass needs to be cut and removed periodically through the growing season

On the majority of farms a corresponding increase in conserved grass supplies would be more readily effected by ensilage, using improved modern methods, and an intensive propaganda directed towards this end ought to be initiated without delay.

By these two methods of conserving young grass, a very substantial reduction in the requirements of ruminant live stock for concentrated foods could be effected, and substantial help thereby given to the solution of the difficult problem of maintaining an adequate head of our non-ruminant stock.

It is on the latter—the pig and the fowl—that the penalty of depleted supplies of concentrates must necessarily fall most heavily, since they can only utilize coarse fodders to a very limited extent, not even sufficient to cover their maintenance requirements, and consequently must depend for the most part upon supplies of grain and meals. According to Wright's estimates of the normal requirements of these classes of live stock under prevailing systems of management, poultry receive 94 per cent, and pigs no less than 97 per cent, of their nutrients (expressed as starch equivalent) in the form of cereals and other concentrates. When these proportions are compared with the corresponding 15–20 per cent for cattle and sheep, and account taken of the paramount importance of maintaining an adequate supply of milk, it is clear that even with drastic changes in systems of management and feeding it will be practically impossible to prevent a considerable fall in the numbers of pigs and poultry. A considerable reduction in the output of pig meat, poultry meat

and eggs from the normal sources of home supply can thus scarcely be avoided, although since the best stocks will be retained the fall in output from these sources will not be proportional to the drop in numbers Greater recourse will also be made by pig and poultry farmers to the feeding of food refuse from hotels and camps, and of grassland and surplus greenstuffs So far as the use of grass and greenstuff is concerned, however, it is one of the ironies of the situation that the main responsibility for this task of replacing concentrates by greenstuffs should fall upon the two classes of live stock that are least fitted for dealing with large quantities of this bulky, fibrous type of food

If home supplies of eggs, poultry meat, and pig meat are to be substantially maintained, a new body of producers must be brought into existence, and that is the task now allotted to the cottager, 'back-yarder', and allotment holder Every household and every vegetable garden produces a certain amount of waste, useless in the house but serviceable as food for small live stock Such material is generally more easily and completely disposed of through the pig than the fowl, but for most people, especially in suburban areas, pig-keeping will be impossible, and the effort must be concentrated on fowls and rabbits War-time economy, moreover, will surely reduce the normal volume of household 'scraps' available, and the keeping of even a few fowls or rabbits will only be possible where an organized collection of the scraps from several households can be arranged In a community properly organized for the purpose, the best plan of all would be for the edible refuse of all kinds to be collected and taken to a communal live stock feeding centre where expert management and proper facilities for the preparation of the food could be provided Such a centre, with good management, might well be a substantial source of profit to the community

Before taking up poultry keeping, the 'back-yarder' will be well advised to bear in mind that his household scraps and garden refuse alone will not suffice to maintain his birds in good health and production, but that he will also need to obtain a quantity of suitable meal, probably at least ¾–1 lb. per head weekly. Furthermore he must be prepared to go to a little trouble in boiling or cooking the scraps, as they may be unsuitable or even unsafe in the raw condition. Where garden waste is more abundant than house scraps he would probably be better advised to keep rabbits than poultry, since the rabbit can deal effectively with larger quantities of greenstuffs than the hen, and is generally less fastidious in its appetite for this class of food. Incidentally also, it is perhaps less liable to create a nuisance. German war-time policy for the 'back-yarder' definitely favours the rabbit before the hen, and its possibilities might well receive more attention and publicity in Great Britain than they have yet received

Whatever class of live stock is favoured, however, it must not be assumed to be a simple matter on which no expert advice is required, and every community in which this class of activity develops should provide an organization through which such help can be readily obtained There should be no difficulty in any town in forming an advisory panel of experienced men and women, with whom might be associated the adviser on small live stock from the agricultural educational staff of the adjoining county authority Further assistance is also available in the special leaflets issued by the Ministry of Agriculture and Fisheries

With all the assistance that may come from the cottager and 'back-yarder', however, the major part of the problem of conserving the greatest possible nucleus of our live stock must lie with the farmer, and must turn upon the efficiency with which our grassland and our reduced supplies of concentrated foods are utilized There is general agreement that in the interests of children and others for whom milk is almost a vital necessity, and in view of our entire dependence upon home supplies of this commodity, priority in the allocation of feeding-stuffs must be given to milch cows. Beef cattle and sheep are regarded as having the next best claim to consideration, partly because of their relatively low requirement of concentrated feeding-stuffs in proportion to their total food consumption, and partly because of the slowness with which any reduction in our cattle and sheep stocks can be remedied after the War Poultry and pigs follow without any special discrimination between them in the national policy, although the poultryman may justly claim precedence on grounds of the special nutritive virtues of the egg, through its combination of high nutritive energy with 'protective' factors From this point of view, indeed, the hen may claim to rank next to the dairy cow in the basic importance of its contribution to the national dietary

Placed at their present disadvantage in the order of priority, the pig farmer and poultry farmer have clearly the right to insist that every care shall be taken to ensure that the more favoured classes of live stock are efficiently managed, especially as regards their user of imported feeding-stuffs. This can only be effected satisfactorily through an organized scheme of rationing of supplies. Under such a scheme the dairyman, cattleman and sheepman should only receive priority supplies for their surplus production beyond the level that they may reasonably be expected to cover from home-grown supplies of fodder and grain. Furthermore, the

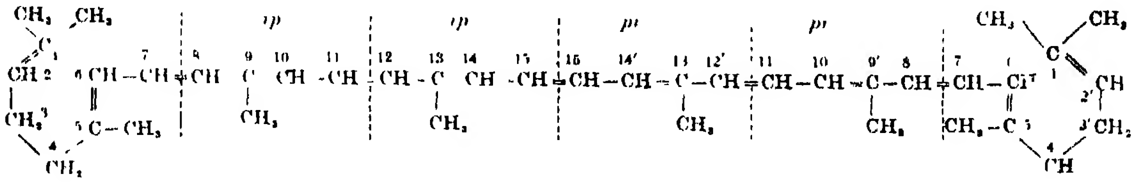
total volume of milk and meat production in respect of which priority of foodstuff supply is given should be restricted to the *essential* needs of the public. A volume of milk, for example, that is ample for the needs of infants, adolescents, invalids, etc., must be assured at all costs; but in view of the serious position in which pig and poultry producers are placed, it is difficult to see why any priority should be given for the production of unlimited supplies of milk for consumption by the adult population.

With the increased arable acreage and intensified utilization of grassland the requirements of the ruminant live stock for imported concentrates should be very substantially reduced, and the pig-man and poultry-man have every right to expect this measure of co-operation from their more favoured fellow farmers.

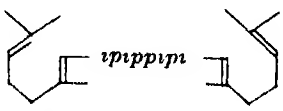
In the case of the poultry-man, and to a smaller degree the pig-man, there are also other weighty considerations that must be taken into account in the development of national policy. A very large section of the poultry industry is in the hands of 'small' people scattered throughout the country-side, whose living and life-savings are entirely bound up with the maintenance of their small enterprises. The welfare of this smallholder element of the agricultural community has always been regarded as being of great importance to the interests of the State, and any ill-considered reversal of this policy, even in war-time, may have grave sociological consequences. Their problem is for the time being extremely difficult, but must receive serious consideration before we can resign ourselves to the inevitability of human sacrifice on the home food production front.

CAROTENE AND ALLIED PIGMENTS*

THE simplest carotenoid is lycopene, $C_{40}H_{56}$; on complete hydrogenation to perhydrolycopene, $C_{40}H_{82}$, thirteen bonds disappear. Quantitative degradation by means of ozone, permanganate and chromic acid as oxidizing agents leads to the formula



The central polyene chain, C_8–$C_{8'}$ inclusive, is made up of four isoprene units arranged in pairs which are united in reverse order at C_{15} and $C_{15'}$, and may be abbreviated as *ipippipi* (*ip* denoting an isoprene unit). Lycopene may thus be written

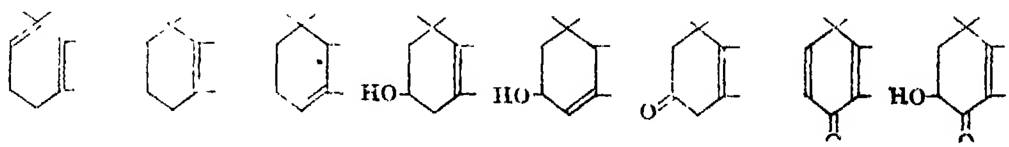


The polyene chain is common to a large number of carotenoids, but the terminal groups may consist of substituted or unsubstituted rings of the α- or β-ionone type as below.

Green leaves and other vegetable products contain α- and β-carotene and 'xanthophyll', a mixture of hydroxylated carotenoids, zeaxanthin and lutein predominating. Their functions in plant physiology are not yet understood, but owing to the connexion between carotene and vitamin A, the position concerning the role of carotenoids in the nutrition of animals is much less obscure.

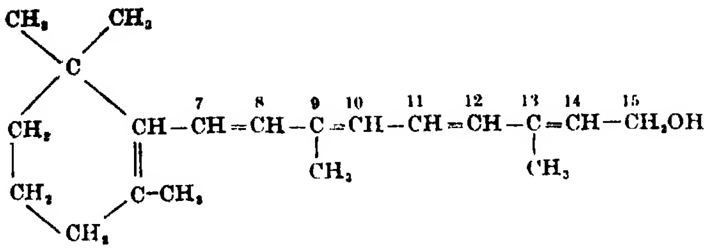
Vitamin A from fish liver oils ($C_{20}H_{29}OH$) possesses a constitution which differs from one half of the symmetrical β-carotene molecule

* Based on papers by Dr. R. A. Morton "On the Constitution and Physiological Significance of Carotene and Allied Pigments" and W. M. Seaber, "On the Commercial Determination of Carotene and Allied Pigments with Special Reference to Dried Grass and other Leafy Materials", read at a joint meeting of the Society of Public Analysts and Other Analytical Chemists and the Food Group of the Society of Chemical Industry on February 7.



a *b* *c* *d* *e* *f* *g* *h*

only by the addition of the elements of water:



The fact that green foodstuffs may cure avitaminosis A just as well as fish liver oils was explained when it was found that pure 'carotene' undergoes fission *in vivo* with formation of vitamin A

The only carotenoids which act as precursors or provitamins A are those which possess intact one half of the β-carotene molecule They include those shown in the accompanying table, echinonene and a few derivatives prepared *in vitro* from natural provitamins There is no evidence that animals can synthesize either provitamins A or vitamin A *de novo*, or that the conversion of carotene to vitamin A is reversible

Substance	Constitution	Occurrence
Lycopene	*a-ipippipi-a*	Ripe tomatoes
* α-Carotene	*b* ,, *c*	Red palm oil, mountain ash berries
* β-Carotene	*b* ,, *b*	Carrots, leaves, etc
* γ-Carotene	*b* ,, *a*	Leaves of lily-of-the-valley
* Kryptoxanthin	*b* ,, *d*	Yellow maize
Zeaxanthin	*d* ,, *d*	Maize, egg yolk, leaves
Lutein	*d* ,, *e*	Grass, green leaves
* Myxoanthin	*b* ,, *g*	Algæ, especially blue-green algæ
* Aphanin	*b* ,, *f*	
Rubixanthin	*d* ,, *a*	
Astaxanthin	*h* ,, *h*	Crustacea

* Provitamins A

The animal body contains only small quantities of carotenoids, and is not equipped to assimilate large doses Carotene utilization is optimal when minimal doses are fed in oil solution, and the transport of carotene through the intestinal wall is conditional on normal fat absorption The site of the conversion of carotene to vitamin A is generally held to be the liver, certainly the liver is the main storage depot for the vitamin In most species there is a normal level of concentration of vitamin A—and of carotenoid—in the blood Carotenoids are also found in the pigmented layer of the eye and in yellow bone marrow.

Milk contains both vitamin A and carotenoids (largely β-carotene) and for a given species the total vitamin A activity of normal milk tends to be fairly constant, but in domesticated animals there are interesting variations with breed. Thus Holstein and Ayrshire cows yield milk with little carotene but more vitamin A, whereas Guernseys give a cream more deeply coloured by carotene but less rich in vitamin A. The new-born possess very low liver reserves of vitamin A, and it is significant that colostrum may possess vitamin A activity one hundred times that of normal milk Human colostrum is two or three times as potent as early milk, which in turn is five or ten times as rich as the later milk.

The earliest sign of shortage of vitamin A or provitamin A is defective low-intensity vision Visual purple, the photosensitive substance of the rods, may be obtained from retinas, it is a conjugated protein from which vitamin A can be separated Faulty dark adaptation is due to delayed regeneration of visual purple, and in the majority of subjects can be remedied by supplementing the diet with vitamin A or carotene. In order to prevent night blindness in cattle, sheep, pigs, rats and horses, Guilbert finds that either some 25-30 μgm/kgm body weight (1 μgm. = 10^{-6} gm) of β-carotene or 6–8 μgm/kgm of vitamin A is needed daily

Outspoken vitamin A deficiency is characterized by widespread atrophy of epithelial structures and often by xerophthalmia, but retardation of growth (weight) is the criterion most readily amenable to quantitative interpretation.

The diet of the majority of town dwellers shows inadequate vitamin A activity, especially during the winter months It is also certain that most winter milk from stall-fed cattle is inferior to summer milk. Artificially dried grass is superior to hay both in respect of protein and provitamin A content, and its value as a feeding stuff has been established in many well-controlled experiments. The addition of vitamins A and D to margarine is a valuable way of alleviating vitamin deficiency, but the problem of utilizing the available resources to the best advantage and of increasing the supply to meet the known needs has not been solved That it is necessary and possible to do so cannot be doubted, nor that the cost of effective action would be a small fraction of the cost of inaction

This raises the point of the relative efficiency of carotene and vitamin A. The accepted unit of vitamin A activity is that exerted by 0·6 μgm. of pure β-carotene, so that the pure substance has a potency of $1{\cdot}66 \times 10^{6}$ I.U./gm. (by definition). Vitamin A, according to the best available data, has a potency near $3{\cdot}0$–$3{\cdot}3 \times 10^{6}$ I.U./gm., whereas all provitamins other than β-carotene have an activity near $0{\cdot}83 \times 10^{6}$ I.U./gm. These figures apply to rats receiving minimal doses.

There is urgent need for more research on the relative efficiencies of provitamins and vitamin A

at the level needed to convert a marginal diet into an optimal diet

The commonly accepted view that the equation

$$\underset{\beta\text{-carotene}}{C_{40}H_{56}} \xrightarrow{2H_2O} 2C_{20}H_{29}OH$$

corresponds with a process occurring *in vivo* would lead to $1 \cdot 56 \times 10^6$ I.U./gm for pure vitamin A. This is not in accord with experience; it rests upon the assumption that fission occurs exclusively at C15–15′ double bond, and its only advantage is that it agrees with the superiority of β-carotene over other provitamins. Unsymmetrical fission is more plausible and an equation

$$\underset{\beta\text{-carotene}}{C_{40}H_{56}} \rightarrow C_{20}H_{29}OH + \text{decomposition products}$$

is in closer harmony with the observed potency of vitamin A.

Vitamin A is estimated spectroscopically by utilizing the absorption maximum at 325 mμ. There is at present no reason to justify changing the accepted conversion factor, namely

$$E^{1\%}_{1\text{cm}}\ 325\ \text{m}\mu, 1 = 1{,}600\ \text{I.U./gm}$$

The estimation of carotene in dried grass and similar materials involves extraction of the pigments, preparation of non-saponifiable extracts and a phase separation (that is, partition between petrol ether and 90 per cent methyl alcohol). The provitamins appear in the hydrocarbon solvent and the xanthophyllic compounds are eliminated in the aqueous methyl alcohol. Chromatographic adsorption permits a finer separation of individual carotenoids, specially prepared alumina, lime, calcium carbonate, magnesia and soda ash being good absorbents for particular purposes. The carotene, freed from 'xanthophylls', is evaluated spectroscopically or colorimetrically.

Dried grass and similar products are now important sources of provitamin A for animal feeding. The following method of analysis has been thoroughly tested and found to be satisfactory by the Grass Driers' Association:

0·25 gm. dried grass is ground thoroughly with sharp silver sand (5 gm.) and the mixture is treated with a mixture of acetone (15 ml.) and petrol ether (45 ml.) in a continuous drip extractor for at least 1 hour. The cooled extract is transferred to a separating funnel using a little petrol for washing in, and 30 per cent methyl alcoholic potash (5 ml.) is added. Vigorous shaking for two to five minutes is followed by addition of water (200 ml.). Carotene remains in the petrol, and after washing with water (200 ml.) the 'xanthophylls' are removed by shaking the petrol ether three times with 90 per cent methyl alcohol. The petrol layer is retained and made up to known volume. A solution of potassium dichromate (0·025 per cent) is colorimetrically equivalent to a solution of β-carotene containing 0·158 mgm. per 100 ml. petrol ether.

The estimation of carotene is complicated by the presence in the petrol ether fraction of a variable amount of an *X*-substance, which may be eliminated by filtering through a short column of alumina after adding 3 per cent of acetone. A yellow impurity is adsorbed but the carotene is carried through. Dr. Kon has confirmed the observation that the percentage of this contaminant increases in dried grass on storage.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COLUMBUS MEETING

BY DR. F. R. MOULTON, PERMANENT SECRETARY OF THE AMERICAN ASSOCIATION

IN many respects the American Association for the Advancement of Science is similar to the British Association, which served as a model for its organization and early development. It is the great democratic scientific organization of America (using the word in the geographical, not the national, sense), including in its interests all of science and its applications and relations to society. During a period of rapid increase in specialization and the organization of special scientific societies, it has served as an integrating agency. The breadth of its scope and the number of its members, now exceeding 20,000, make its voice more and more the voice of science in America.

In certain respects, however, the American Association differs from the British Association. Perhaps the least important is that it holds two meetings each year, the annual meeting during the Christmas holiday week (this year December 27—January 2, inclusive) and another meeting in the summer, usually the latter part of June. In addition, because of the large area of America, it has two geographical divisions, the Pacific Division and the Southwestern Division, each of which holds one meeting each year. A greater difference between the two associations is in the nature of their programmes. Before stating this difference, I wish to point out that many special scientific societies and organizations, at present 174 of them, are affiliated with the American Association, meet

with it at their option, and have representation on its Council, its supreme governing body. As a consequence of this organization, the American Association programmes, instead of consisting of a rather small number of important addresses by distinguished men of science, include many sessions before which hundreds of papers are read. At the recent meeting in Columbus, Ohio, in about four days a total of 259 scientific sessions were held, before which 2,154 addresses and papers were presented Naturally there was none of the delightful leisureliness of the meetings of the British Association.

Although many, probably most of the 2,154 papers presented at the Columbus meeting were of no considerable importance, yet a considerable number were distinguished As an example, I may refer to the paper by I I Rabi on "Radio Frequency Spectra of Atoms and Molecules", for which the Thousand Dollar Prize of the Association was awarded. Dr Rabi not only discovered radiations from atoms of much lower frequency than hitherto known, but also devised a method of determining their properties although they are far too feeble to be detected by any of the devices previously in use It is not possible to pick out from the hundreds of other papers—75 in physics, 44 in chemistry, 56 in astronomy, more than 300 in the zoological sciences, more than 350 in the botanical sciences, an equal number in genetics and other general biological sciences, 67 in the medical sciences, 310 in agricultural science—a few for special comment without injustice to many others.

On the whole, the best part of the programme from the point of view of direct contributions to science was the symposia, often organized and presented by several sections and societies in co-operation These symposia were on such subjects as "Applications of Mathematics to the Earth Sciences", "Photosynthesis", "Fifty Years of Entomological Progress", "Speciation", "Effects of Science upon Human Beings" and "Blood, Heart and Circulation". The Association has published in book form the most important of the symposia presented at its meetings during the past three years.

Perhaps the foregoing paragraphs might lead the reader to conclude that the programmes of the American Association do not include the general sessions which are so characteristic of meetings of the British Association. The American Association has such general sessions, often of distinction, but relatively to the remainder of its programme they are much less important than those of the British Association. In addition to the address of the retiring president of the Association, there are two regular evening general sessions, one under the auspices of the Society of the Sigma Xi, an honorary scientific society, and one under the auspices of the Phi Beta Kappa, an honorary scholarship society. The retiring president of the Association, Dr Wesley C Mitchell, chose for the subject of his address "The Public Relations of Science" [see NATURE, Feb 10, p. 207]. The annual lecture under the auspices of the Society of the Sigma Xi was delivered by Dr. Kirtley F. Mather on "The Future of Man as an Inhabitant of the Earth" The Phi Beta Kappa address was by Dean Marjorie Hope Nicolson on "Science and Literature"

This year saw the initiation of two new general sessions, one under the auspices of the Honor Society of Phi Kappa Phi and the other under the arrangement between the British Association and the American Association for exchange lectures on alternate years The former was delivered by Dr Isaiah Bowman, president of the Johns Hopkins University, whose subject was "Who is Responsible for Peace ?" As British men of science will recall, Dr Bowman was invited by the officers of the British Association to deliver at its meeting last September the first of the British and American Association Lectures.

Although the first lecture by a British man of science under the arrangement was not due until next June, the arrival of Dr Julian S. Huxley in America just before the Columbus meeting presented an opportunity that could not be neglected He was invited to deliver the first lecture by a British scientific worker and accepted the invitation His subject was "Science, War and Reconstruction" In referring to this brilliant address in my report of the meeting, I wrote as follows:

"The address of Dr Huxley illustrated the scientific ideals of impartiality, justice and altruism, not simply as ideals without immediate applications but as ideals that are urgently needed at this hour. Obviously there is now a tide in the affairs of scientists that taken at its flood may enable them to make the greatest contribution to the progress of mankind in the history of the world, but neglected may leave them in the position of having provided the bark on which civilization will drift back into the darkness from whence it came. It is gratifying that so many addresses and programs of the association and its affiliated societies gave concrete evidence of a deep feeling of responsibility of scientists to society These responsibilities include also the more fundamental one of laying foundations for an organization of society based on the essential nature of man ; and they include the still deeper one of deriving from the laws of the inanimate and animate universes about us and within us a basis for ethics whose authority for acceptance shall be in our own hearts."

OBITUARIES

Prof. Alfred Wohl

PROF. ALFRED WOHL died in Stockholm on December 25, 1939, at the age of seventy six years. He was born on October 3, 1863, at Graudenz and received his early training at the Universities of Heidelberg and Berlin He obtained his doctorate in 1886 at the University of Berlin, working under the supervision of Prof A W von Hoffman, and spent the next two years in the Laboratorium des Vereins fur Rubenzuckerindustrie, Berlin. In 1891 he became *Privat-dozent* in Emil Fischer's laboratory in the University of Berlin, and in 1904 was appointed director of the Laboratory for Organic Chemistry and Technology at the Technische Hochschule, Danzig, a post which he held until he retired on reaching his seventieth birthday in 1933

During a period of almost fifty years uninterrupted research, Wohl made many important contributions to both organic and physical chemistry His early connexion with the sugar industry probably laid the foundation for his deep interest in this branch of organic chemistry We owe to him methods for the degradation of sugars, the preparation of the optically active glyceraldehyde and much of our early knowledge of fermentation enzymes He also devised methods of making artificial honey which are still in use to-day, and during the War of 1914 18 produced an economical process for growing yeast

In other branches of organic chemistry, Wohl carried out the synthesis and investigation of many important compounds such as phenylhydroxylamine, the semi-aldehyde of malonic acid, malic and tartaric dialdehydes, lactic acid aldehyde, the acetal of methyl glyoxal, and the preparation of glyoxal by the interesting method of the ozonization of acetylene He also showed that nitrobenzene reacts with potash to give nitrophenol.

One of Wohl's outstanding achievements was the demonstration of the wide applicability of vanadium pentoxide as an oxidation catalyst, by its use he carried out the oxidation of naphthalene to phthalic anhydride and of anthracene to anthraquinone, and thus opened a new path to the cheap production of intermediates for the dyestuffs industry.

Wohl always showed a fervent interest in the theoretical aspects of organic chemistry, and developed a theory of chemical reactivity based on Michael's theory of primary association of reaction spots and on the polarity of linkages Much of his work was devoted to the substantiation of these ideas and in this respect he made special studies of the reactivity of bromacetamide, hydrazonium compounds, and of the Friedel-Crafts synthesis His interest in theory extended to physical chemistry and his most important contribution in this field was the formulation of an equation of state for gases, based upon a simple modification of van der Waals' equation He also published a series of papers in the *Berichte* on methods of analysis of gases. In developing these methods, he devised a new type of glass tap and also a means of producing vacua suitable for low-pressure distillations by the use of charcoal cooled by liquid air and an ordinary filter-pump

Wohl was a man of outstanding personality and an enthusiastic, ardent, and inspiring teacher He spared no effort to help his students, and during term it was his daily practice to gather them together in small groups in the laboratory and discuss with them their research problems

Many honours were conferred on Wohl He held the office of president in the Deutsche Chemische Gesellschaft in 1933 and was given the honorary degree of Dr Ing of the Technische Hochschule, Hanover, in 1928, and Dr Agr of the Landwirtschaftliche Hochschule, Berlin, in 1931

Although he retired in 1933, he carried on experimental work until 1938, and in his last years developed a process for the manufacture of pulp from fibrous vegetable materials

Mr. R. A. Smith

WE regret to record the death, at the age of sixty-six years, of Mr Reginald A. Smith, formerly keeper of the Department of British and Medieval Antiquities of the British Museum, which took place at Colchester on January 13.

Reginald Allender Smith was born in 1873 and educated at Christ's Hospital and University College, Oxford In 1898 he was appointed to the staff of the British Museum in the Department of Ethnography and British and Medieval Antiquities, as it then was, of which Charles Hercules Read was at that time keeper Smith was assigned to the archæological collections, of which he became keeper in 1927, after the ethnographical collections had become a distinct department He retired in 1938.

Smith was fortunate both in his chief and in the nature of his duties—the care and arrangement of the prehistoric and early historic collections of antiquities of the Museum. By his association with Read he was trained in that appreciation of the significance of form and technique in which his chief was pre-eminent, while his care for, and arrangement of, the collections committed to his charge developed to the full his capabilities of scientific precision in observation and interpretation of detail which enabled him during a period of nearly forty years to make to the advancement of archæological studies a contribution which was no less valuable than it was individual, and, indeed, unique.

A variety of circumstances combined to afford Smith the opportunity to attain the position which he afterwards held in the archæological world. Of these, one of the most influential was the part assigned to him in carrying out the policy initiated

early in his career at the Museum of issuing guides to the archæological collections, of which the first, on the Stone Age, appeared in 1902. Smith was mainly or solely responsible for the valuable guides, both in the original and in the revised editions, to the Stone, Bronze, and Iron Ages collections as well as to those of the Romano-British and Anglo-Saxon periods

The preparation of these guides demanded an intimate and detailed knowledge and understanding of the characteristics of each individual specimen in the collections in relation to general typology as well as to the development of theoretical reconstruction in prehistoric and early historic studies. An even broader view was demanded in Smith's contribution of archæological chapters to early volumes of the "Victoria History of the Counties of England", which had commenced publication also early in Smith's career.

This thorough grounding in knowledge of the detailed evidence bearing upon British archæology proved of enormous service to scientific studies when Smith in 1908 joined the Council of the Society of Antiquaries of London, and afterwards became its honorary secretary and then its director, an office which he held for many years. Through the ramifications of the Society's many activities he was in close touch with archæological research in the field throughout Britain as well as on the Continent. Not only did he himself make many valuable contributions to archæological literature in its technical periodicals—his most considerable publication was an exhaustive illustrated catalogue of the Sturge collection of stone implements—but also he came to be widely recognized as, in a sense, a court of final appeal on the value and significance of any new discovery, or any fresh evidence bearing on previously ascertained facts in the prehistoric field of Britain In the records of archæological discovery of the last twenty years, no name, with the possible exception of that of the Abbé Breuil, is more frequently quoted as responsible for an authoritative and final opinion than that of Reginald Smith.

Mr. G. L. Bates

MR. G. L BATES, who died on January 31, was born in the State of Illinois in 1863 He was the eldest son of a large family, and inherited his love of natural history from his mother. He was educated at Galesburg and Chicago, and it was his father's wish that he should enter the Church. However, he had a great desire to travel and study Nature, and he persuaded his father to send him to West Africa in 1895. His first years were spent in Gabon and the French Congo, and later he settled in the former German colony of Cameroon.

In 1896 Bates began to send collections to the British Museum, and up to 1928 there was a steady stream of specimens in all groups. Though primarily an ornithologist, Bates did not confine his collecting to birds, and he had the reputation as a very successful collector of reptiles, discovering some sixty-two new species, including *Rana goliath* and *Trichobatrachus robustus*, the curious hairy frog. In mammals, too, he made many discoveries, and his specimens of plants and fishes are models of careful collecting. From 1923 onwards he made many expeditions to different parts of West Africa, including a trip to the Southern Sahara, where he made some interesting observations on the affinities of the Saharan avifauna Later he undertook the study of Arabian birds, and in 1934 paid a visit to Mr. H St J Philby at Jedda.

Apart from his expeditions, Bates will always be remembered for his papers on the reversed underwing coverts of birds, and his study of the genus Smithornis. In this last he proved by anatomical evidence that the genus had nothing to do with the normal Passeres This was confirmed later by P. R. Lowe, who demonstrated that the true position was in the Asiatic Eurylæmidæ Perhaps Bates's most important contribution to ornithology was on the "Geographical Variation within the Limits of West Africa", in which he showed that these variations, whether in colour or size, fall within certain rules. In 1930 he published a useful little "Handbook of the Birds of West Africa".

Bates's shy and retiring nature was increased by long residence alone, but nevertheless, no one was more ready to help others, and he will be missed by many In the late autumn he underwent a serious operation from which he never fully recovered.

N B. KINNEAR.

Prof. Fritz de Quervain

PROF. FRITZ DE QUERVAIN, an eminent Swiss surgeon, who died last month at the age of seventy-one years, was born at Sion, the capital of the Valais Canton, on May 4, 1868 He received his medical education in Bern, where he was assistant to Kronecker the physiologist from 1889 until 1891 and to Langhans the pathologist from 1891 until 1892, when he qualified. For the next two years he was assistant in Kocher's surgical clinic, and then entered on a surgical practice at Chaux-de-Fonds, where he became director of the surgical clinic in 1897 In 1902 he returned to Bern, where he remained until 1909, when he was appointed professor of surgery in the Basle faculty of medicine, and finally in 1918 occupied the corresponding chair at Bern.

WE regret to announce the following deaths.

Lieut.-Colonel J A. Amyot, C.M G., lately Canadian deputy minister of pensions and national health, formerly professor of hygiene in the University of Toronto, aged seventy-two years.

Colonel R. E B. Crompton, C.B., F R S., a pioneer in electrical engineering and mechanical road traction, on February 15, aged ninety-four years.

Mr. H. G. Newth, lecturer in zoology in the University of Birmingham, on February 17.

Prof. C. Tangl, director of the Institute of Experimental Physics, University of Budapest, on December 10, aged seventy-one years.

NEWS AND VIEWS

Waynflete Professor of Physiology, Oxford

ANNOUNCEMENT has been made of the appointment of Dr E. G. T. Liddell, of Trinity College, Oxford, to the Waynflete chair of physiology in the University of Oxford, which has been vacant since last autumn owing to the death of Prof J Mellanby Dr. Liddell graduated in medicine from Oxford and St Thomas's Hospital, and returned to the University as assistant in physiology in 1921 He collaborated in much of the later work of Sir Charles Sherrington, including the studies on the stretch reflex, the publication of the "Reflex Activity of the Spinal Cord", and the revised second edition of "Practical Exercises in Mammalian Physiology" He was thus intimately associated with the Sherrington School His particular interest has naturally been the physiology of the nervous system, and his more independent published papers have been concerned with studies on the knee-jerk, physiology of the cerebellum and spinal cord He has also published work on the experimental production of high blood pressure in animals Latterly he has elaborated a technique for study of the postural reactions in the limbs of the intact animal over a long period of time, thus exploring the effects of lesions of the spinal cord and corpus striatum by operative means He has made himself an authority on this particular branch of the subject, hitherto neglected in Great Britain.

Prof Liddell was elected fellow of the Royal Society last year As fellow of Trinity College, Oxford, since 1921, he has gained a wide reputation as tutor and will be greatly missed in this sphere of university life. His long experience as examiner and tutor, his wide interests and thoughtful outlook, all combine to make him unusually well suited to the chair, and we wish him every success

Guthrie Lecturer of the Physical Society

THE twenty-fourth Guthrie Lecture of the Physical Society will be delivered at 5 30 on February 26 at the Royal Institution by Prof P M S. Blackett, professor of physics in the University of Manchester. The subject of the lecture is "Cosmic Rays · Recent Developments" Prof Blackett served with the Royal Navy in 1914 19, having previously been at the Royal Naval Colleges at Osborne and Dartmouth. After the War he exchanged a naval for a scientific career and went up to Magdalene College, Cambridge. In the Cavendish Laboratory he began work with the Wilson cloud chamber, a technique of research to which he has remained faithful His work during 1923-1933 was concerned with the alpha particle. He showed that alpha particles make nuclear collisions in which energy and momentum are very accurately conserved, but he also investigated collisions resulting in nuclear disintegration, and showed, for the first time, that in a Rutherford disintegration of the nitrogen nucleus the alpha particle is absorbed and a proton liberated

In 1932 Blackett developed the counter-controlled cloud-chamber device—a method of using the cloud chamber in which the expansion is initiated by the passage of the particle to be photographed. This has proved to be a most valuable instrument. This work led immediately to the detailed study of cosmic ray particles, and Blackett and Occhialini found, almost at the same time as Anderson, that positively charged particles of electronic mass occur in the cosmic rays With Chadwick and Occhialini, Blackett showed the formation of positrons by the passage of hard gamma rays through lead. Since that time Blackett has concentrated almost entirely on the subject of cosmic rays He has initiated investigations at Cambridge, at London (Birkbeck College) and at Manchester, indeed most of the experimental work on cosmic rays in Great Britain has been inspired by him more or less directly. His own work has been chiefly concerned with the energy spectrum of the particles, which he has investigated by means of a very refined cloud chamber in a strong magnetic field.

Prof. D. R. R. Burt

MR. DAVID R R BURT, who has just been made professor of zoology in University College, Colombo, has had charge of his department since 1924, and has raised it from small beginnings to a school of more than a hundred students Prof. Burt is a graduate of St Andrews, and was at one time an assistant to Sir D'Arcy Thompson; he also worked under Hans Przibram in Vienna He has studied, among other things, the very numerous cestode parasites of the Ceylon fauna Some years ago he devised, and described in NATURE, a method of anatomical injection with rubber-latex which has great advantages and has come into everyday use, especially in America.

Centenary of Sir Hiram Maxim

AMONG the great mechanical inventors of last century, none was known to a wider public than Sir Hiram Maxim, who was born on February 25, a century ago When he came to Europe in 1881 to attend the Paris Exhibition, he was the engineer of the first electric light company in the United States, but was known to few in Great Britain. He had, however, already taken out a goodly number of patents, had invented a gas-making machine for lighting buildings and had done much original work on the incandescent electric lamp, dynamos, regulators, boiler plant and suchlike. When on the Continent, his attention was attracted to the subject of machine-guns. His countrymen Gatling, Gardner, and Hotchkiss had all invented machine-guns, and so had the Swedish engineer Nordenfelt. None of their guns, however, had proved entirely satisfactory.

In Paris Maxim drew the design of his gun, and his original gun was made in a workshop at 57A Hatton

(*Continued on page* 299)

NATURE

SUPPLEMENT

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SHORT REVIEWS

Biology

(1) Bacteriology
For Medical Students and Practitioners. By Prof A D Gardner (Oxford Medical Publications) Second edition Pp viii+274 (London · Oxford University Press, 1938) 6s net

(2) The Microscope Made Easy
By A Laurence Wells. Pp 182. (London and New York · Frederick Warne and Co., Ltd, 1938) 3s 6d net

(1) PROF GARDNER has managed to include in this small book a surprising amount of information on bacteriology, which is adequate for the medical practitioner who desires to keep abreast of advances in the subject, as well as being detailed enough for the medical student, with some supplementary reading. The matter is well presented and readable, singularly free from errors, and well up to date. Apart from the descriptions of the pathogenic micro-organisms and their effects, such subjects as immunity and antibody-antigen reactions, agglutination and anaphylaxis, and bacterial variation, are particularly well done, and the author has managed to include short sections on disinfection and the bacteriology of water and milk. The additional chapter on viruses in this second edition gives an excellent general account of the subject, together with sections on microscopical visibility and the bacteriophage. This is a book that can be cordially recommended.

(2) Mr. Wells's book, as its title implies, is a simple guide to elementary microscopy. The descriptions are easy to follow, and accounts are given of the microscope, and how to examine and mount a number of objects—crystals, pond life, diatoms, etc The book contains several plates which satisfactorily illustrate and name a number of the objects mentioned in the text. The beginner without previous knowledge of microscopy will find it a useful first book on the subject. R. T. H.

The Fauna of British India, including Ceylon and Burma
Edited by Lt-Col R B S Sewell (Published under the Patronage of the Secretary of State for India) Butterflies Vol 1 By G. Talbot Pp xxix+600+3 plates (London. Taylor and Francis, Ltd, 1939) 35s

SINCE the publication of Bingham's volumes in the Fauna of India series in 1905 and 1907, knowledge of Indian butterflies has progressed very considerably. The issue of new volumes on these insects is, therefore, justified In the present book there is a general and rather elementary introduction to certain aspects of the subject as a whole. External characters, variation, mimicry and distribution are dilated upon in this chapter the rest of the volume is devoted to accounts of the species belonging to the families Papilionidæ and Pieridæ and, whenever possible, descriptions of the early stages are included.

The present work is uniform with the other volumes in the series and maintains the standard already established by its predecessors It is a book which all who wish to know about Indian butterflies will need to consult Some time will evidently elapse before the work is brought to completion by subsequent volumes, since only about one seventh of the recognized species are dealt with in the present contribution

The Structure of Economic Plants
By Prof. Herman E. Hayward Pp. x+674. (New York: The Macmillan Company, 1938.) 22s. net.

THIS volume is an outgrowth of the author's courses in plant anatomy at the University of Chicago. It is divided into two parts, the first dealing with general plant anatomy, and the second with the structure of a selection of plants of economic value. These are chosen partly for their economic importance, partly as typical representatives of the various families, and partly for their anatomical

complexity Fruit crops are omitted, as the author plans a second volume devoted especially to them.

Part 1, consisting of 109 pages, is an excellent condensed introduction to vegetable anatomy. In Part 2, the structure of the selected crops is treated in detail and full references to literature are given. It is, in effect, a series of monographs, and should prove very valuable to any research worker who requires an account of the basic anatomical structure of the plant he is dealing with A special feature is the number of diagrams showing the course of vascular bundles in stems and other structures. Throughout the book the copious illustrations are, with one or two exceptions, clear and well drawn

In matters not purely anatomical, the author's high standard is not always maintained. For example, in the discussion of the hybrid origin of 'Grimm' and other variegated alfalfas, the important genetical work of Urban (1877) and others, which puts this origin beyond doubt, is not mentioned In the glossary, phylogeny is defined as "the developmental history of a race rather than an individual"; it would surely be preferable to substitute a broader term, such as 'group', for 'race', which has a too restricted connotation.

L'Acide ascorbique dans la cellule et les tissus

Par Prof. A Giroud (Protoplasma-Monographien, Band 16.) Pp vi+187 (Berlin Gebruder Borntraeger, 1938.) 12 gold marks.

IN this monograph the sixteenth of the well-known "Protoplasma" series—Prof. A. Giroud develops, from an account of his own and other histochemical studies on the distribution of ascorbic acid in plant and animal cells, an interesting general discussion of the biological function of the vitamin Although his treatment is sometimes rather speculative and often superficial, it provides a highly stimulating review of the large literature that has grown up since Szent-Györgi announced the discovery of 'hexuronic acid' ten years ago It well repays reading J C D.

Chemistry

A History of Chemistry

By Dr. F. J Moore Revision prepared by Prof William T Hall (International Chemical Series.) Third edition Pp xxi+447. (New York and London McGraw-Hill Book Co, Inc, 1939) 20s

IN this revised edition of a well-known and valued work, the account of the earlier period has been greatly extended and new material has been added in most parts of the text. A valuable feature of the book is the attention given to American chemists; it is not generally known, for example, that Crafts was an American, although much of his work was done in France. The history is brought down to recent times, although some of the sections dealing with atomic structure are now in need of revision, and the statement on p 406 as to the possible future use of the electron theory in organic chemistry needs rewording, in view of the extensive applications which have been made in this field The text is very accurate and very few slips have been noted; among these is the statement on p. 337 that Mitscherlich was Russian, and the name Rausch on p. 429 for Ruark. The book is most attractively written and displays a truly philosophical outlook throughout; the new edition may be cordially recommended both to students and also the general reader The large number of interesting illustrations should be specially mentioned.

Hand- und Jahrbuch der chemischen Physik

Herausgegeben von A. Eucken und K. L Wolf. Band 10, Abschnitt 3: Starkeffekt, von B. Mrowka; Elektrischer Kerr-Effekt (Elektrische Doppelbrechung), von H A. Stuart Pp 110+vi. (Leipzig. Akademische Verlagsgesellschaft m.b H, 1939.) 12 gold marks

THE first twenty-six pages are devoted to the Stark effect. This brief article will prove useful alike to physicists and physical chemists It is written in a clear, straightforward style After dealing with the Stark effect of hydrogen atoms and helium ions, consideration is given to the Stark effect of helium atoms, of atoms with more than two circum-nuclear electrons, and of molecules The article concludes with a treatment of the relationship between the Stark effect and other phenomena

All who are interested or engaged in problems of molecular structure will welcome Dr Stuart's capable summary of the electro-optical effect first observed by Kerr in 1875 and named after him. A discussion of the theoretical aspects, occupying twelve pages, is followed by an account of the methods used in the investigation of the effect. Various factors which influence the effect are discussed and the magnitude of the influence of each is indicated The last thirty pages illustrate the application of Kerr effect data to problems of molecular structure Tables of selected reliable data and an extensive bibliography are given.

Both articles are treated in a clear, competent manner and can be recommended to all interested in these topics

Inorganic Chemistry

By Fritz Ephraim. Third English edition. By Dr. P. C. L. Thorne and Dr. A. M. Ward. Pp xii+912. (London and Edinburgh: Gurney and Jackson, 1939) 28s net

IN preparing the new edition of this well-known book, the editors have made a number of useful additions covering recent work and have revised several parts of the text. There are still some parts of the old text which should be removed, as they are in contradiction with the new material. The point of view is more modern than was the case in previous editions, particularly in the sections dealing with co-ordination compounds, and the book is certain to maintain its well-deserved popularity with advanced students. It provides a very good survey of modern inorganic chemistry in a reasonable compass, and the references to the literature will enable

both teachers and students to amplify the information on any particular subject. The printing and lay-out are very good and the book is pleasing in appearance; the price is very reasonable.

Geography and Travel

Transport in Many Lands
By W Robert Foran. Pp. 260. (London and New York: Frederick Warne and Co. Ltd, 1939.) 7*s.* 6*d.* net

MR FORAN'S "Transport in Many Lands" is not, as its title may seem to suggest, a systematic account of the various methods of transport practised by different peoples, but to the general reader it will probably prove more entertaining It is a record of personal experience and observation, more especially in the indulgence of a personal preference for animal transport, in the course of some forty years of travel in many of the remoter quarters of the globe The elephant holds pride of place, both as a worker in the teak forests of the East, and as an impressive member of the pageantry of eastern princes Some of the instances of its intelligence when logging timber are indeed, as the author describes them, almost 'uncanny' Next to the elephant comes the camel, which as Mr Foran points out, when discussing ancient trade routes, is one of the most ancient forms of animal transport on an economic scale employed by man One of the most surprising uses, to which the author has put it, is as a mount for polo in Egypt. Apparently the experience was enjoyable Following on the llama in South America and yak in Tibet, Mr. Foran deals with pack animals, the horse, mule and donkey, and then reindeer, oxen, and dogs, concluding with a chapter devoted to some of the strange vehicles and methods of transport he has seen, in which the power of man himself is harnessed. It is perhaps scarcely necessary to point out in reference to Mr Foran's account of the reindeer that the Samoyedes and Ostiak of Siberia are not Eskimo

In his forty years of observation Mr. Foran has witnessed a vast extension of European methods of transport among backward peoples in the use of the car and the bicycle Nevertheless he shows how, under the influence of environment and tradition, old-fashioned methods still in many regions maintain their vitality, and usually for good reason

L'Asie centrale soviétique et le Kazakhstan
Par Charles Steber. Pp. 302. (Paris: Éditions Sociales Internationales, 1939.) 35 francs.

THE part of Central Asia formerly known vaguely as Russian Turkestan and now comprising several autonomous republics of the Soviet Union is little known and is treated mainly in books which lack recent information. For the main part, it is an area of vast and somewhat arid plains extending southward from Siberia and eastward from the European plain, but it comprises also the mountainous little explored area in which lie much of the Pamirs and allied ranges. Formerly it was a land of sparse population and nomadic tribes, but all that is changing. Soviet influence has begun to develop its resources on a large scale. Irrigation, where possible, has led to agriculture, and the cotton output, not to say its manufacture, is already considerable. Public works, roads, railways and schools have been built, and even in the remoter mountain areas Russian influence is spreading. The author of this small but informative volume gives a clear record of the land and its progress, although his physical introduction is somewhat brief. There are simple but adequate maps and many references to authorities.

Geology

Elements of Geology
With Reference to North America By Prof. William J Miller. Second edition. Pp. x+524. (London: Chapman and Hall, Ltd., 1939.) 21*s.* net.

ALTHOUGH prepared primarily for American students, Prof Miller's text-book is written in such a simple and interesting style and is so well illustrated that it should have a wide appeal. Indeed, the author arouses interest in the science at the outset, for he takes the novel course of describing, in his opening chapter, the evidence for upward and downward movements of the earth's crust and the phenomena of earthquakes—both subjects not too remote from everyday life Thence he leads the reader to the study of minerals and rocks, weathering, rock-structure, and the work of rivers, glaciers, wind, the sea, underground water, and volcanoes. The development of scenery is also simply described Having regard to the vast accumulation of data relating to these subjects, every author of a text-book must decide what to omit and here Prof Miller's selection seems to have been judicious

The second half of the volume is concerned with historical geology and, except for the penultimate chapter on Cenozoic life, has reference only to North America Dull stratigraphical details are avoided so far as possible and full use is made of palæogeographical maps. The section on early man in the chapter on Cenozoic life has necessarily, however, been largely compiled from the records found in the Old World, and here the author is rather less happy in his summary than elsewhere in the book. A study of articles recently published in NATURE would afford him material help, and the author might find it worth while to seek the assistance of some geological and archæological friends in Europe in wending his way through the tangle of conflicting accounts of the history of man The volume is of such quality as to justify the effort

Ground Water
By Prof. C. F. Tolman. Pp. xvii+593. (New York and London: McGraw-Hill Book Co, Inc., 1937.) 36*s.*

THIS book makes a notable addition to the literature of ground-water hydrology. The author assumes the reader to possess an elementary knowledge of geology and of hydraulic engineering,

and the introductory historical chapter mentions the importance of co-operation between geologist and engineer in the study of sub-surface waters. Chapter ii states the general principles controlling the occurrence and behaviour of ground-water, with terms defined, and is intended to provide a summary suitable for the lawyer preparing litigation on the subject; numerous page-references are given in the index under the general heading 'Litigation'. Chapters follow with a detailed discussion of rainfall, porosity, soils, flow of ground-water, and the water-table, the last containing a 24-page appendix on prospecting for water by geophysical methods, contributed by C. A. Heiland

Selected references to literature (mainly American) are given at the end of each chapter Water in fractures, artesian supplies, wells, oil-field fluids, and springs form the subjects of further sections The last two chapters deal respectively with quantitative methods of measurement (with extracts from publications by O. E Meinzer) and the distribution of underground water in the United States and the Hawaiian Islands The book is illustrated by 189 good text-figures, most of the water-table contour maps in Chapter ix lack a statement of scale, which would have been helpful in estimating water-table gradients There is a useful glossary of more than a hundred terms and a generous index

MATHEMATICS

An Introduction to Modern Statistical Methods

By Paul R Rider. Pp ix+220 (New York: John Wiley and Sons, Inc.; London Chapman and Hall, Ltd., 1939.) 13*s.* 6*d.* net

THIS text-book on statistical methods is intended for the student who is interested in applications, but who at the same time, while not aiming at a complete knowledge of the underlying mathematical theory, would like to get a grasp of the main principles and formulæ It is thus introductory both to theory and application, and although the discussion sometimes seems more fragmentary than one would wish, the author has welded the two aspects together into a fairly unified course

The statistical concepts of frequency distributions, averages and moments, regression, and correlation, are first explained, before sampling and significance problems are dealt with. After a chapter on the binomial and normal distributions, the author then discusses the use of "Student's" and the χ^2 distributions, before concluding with the general principles of analysis of variance and experimental design. Statistical tables required for significance tests are included at the end of the book, and appended to each chapter is a useful collection of examples. It should be noted that in his discussion of the χ^2 test of goodness of fit (p. 108), the author omits to warn the reader of the necessity for *efficient* estimation of unknown parameters; in fact, the whole problem of estimation, even for an introductory text-book of this kind, seems scarcely adequately discussed. M. S. B.

An Introduction to the Theory of Functions of a Real Variable

By S. Verblunsky. Pp. xi+170. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 12*s.* 6*d.* net.

TO the ordinary mathematical student, geometrical illustrations in a text-book on analysis are a relief and an inspiration; to the purists the use of figures is a weakness They demand that the theory shall be based on arithmetical considerations alone. Mr Verblunsky's treatise completely satisfies this demand. For the student of analysis who is already acquainted with the subject, a careful reading of this book should be a useful discipline in careful and logical statement. For the usual type of honours student a course of this kind would, we fear, be disastrous

The volume starts at the beginning of the subject—with the positive integers—and leads on by carefully graduated steps to the study of functions, sequences, derivatives, limits and integrals, closing with a chapter on infinite series. There are numerous illustrative examples, most of them fully worked out; but no sets of examples for practice are provided.

Mr. Verblunsky's exposition is, in the main, clear, concise and accurate We deprecate, however, his method of introducing irrational numbers. This he bases on the following "Postulate of the Continuum" If, for every n,

$$a_n \leqq a_{n+1} \leqq a_n + (\tfrac{1}{2})^n,$$

then there is just one number ξ such that, for every n,

$$a_n \leqq \xi \leqq a_n + (\tfrac{1}{2})^{n-1}$$

This postulate is flung at the reader with practically no explanation or discussion. The effect on the beginner is bound to be bewildering. If the book is to be used as a text-book it will be necessary for the teacher to lead up to the postulate by some sort of explanatory introduction.

MEDICAL SCIENCE

Medical Entomology

With Special Reference to the Health and Well-being of Man and Animals. By Prof. William B. Herms. Third edition, based on the book known as "Medical and Veterinary Entomology". Pp. xx+582. (New York: The Macmillan Company, 1939.) 24*s.* net.

WITH the present volume, and those by Matheson and by Riley and Johannsen, the student of medical entomology is very well catered for in North America. Prof. Herms has, in this book, brought out a complete revision of his "Medical and Veterinary Entomology", the second edition of which appeared in 1923. Since that time an enormous amount of information has accumulated. Its sifting and compression, necessitated in a book of this kind, is no light task, and Prof. Herms has accomplished the feat with notable success.

All the more important diseases and other affections of man, and of domestic animals, in which insects and arachnids are implicated as carriers or as

causative agents, come in for discussion. In addition to six chapters of a more or less general character, some fourteen chapters are devoted to insects in relation to disease, two chapters to arachnids in the same connexion, together with a chapter on venomous and urticarial arthropods and a final one dealing with the utilization of arthropods in medical practice

Written in a clear, terse style, a great deal of valuable information is compressed in rather fewer than 600 pages. Prof. Herms's book can be confidently recommended as an up-to-date guide to its subject.

The Genuine Works of Hippocrates

Translated from the Greek by Dr Francis Adams Pp. ix+384+8 plates (London: Baillière, Tindall and Cox, 1939.) 13*s* 6*d*

THIS volume appears to be a reproduction in book form of Francis Adams' translation for the Sydenham Society in 1849, which Dr Emerson Crosby Kelly, the editor, had already published in *Medical Classics* for September, October and November, 1838 It contains the following works of Hippocrates which Adams regarded as genuine: The Oath, On Ancient Medicine, On Airs, Waters and Places, On the Prognostics, On Regimen in Acute Diseases, First and Third Books of the Epidemics, On Injuries of the Head, On the Surgery, On Fractures, On the Articulations, Mochlicus, Aphorisms, the Law, On Ulcers, On Fistulæ, On Hæmorrhoids, and On the Sacred Disease. The present edition has the advantage over the Sydenham Society's publication in consisting of only one volume instead of two, but this has been effected by the omission of (1) Adams's Preliminary Discourse, which deals with the life of Hippocrates, his disquisition on the authorship of the different treatises attributed to Hippocrates, and the physical philosophy of the ancients, (2) Adams's introductions to the various treatises contained in the volume, and (3) almost all the footnotes as well as a considerable number of the entries of the index. The present edition, therefore, will be more acceptable to the general reader than to the medical historian, who will miss the learned commentaries of one of the most famous authorities in classical Greek medicine.

MISCELLANY

The Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland

With a Record of Publications issued during Session 1938–1939. Compiled from Official sources. Fifty-sixth annual issue. Pp. vii+175 (London: Charles Griffin and Co., Ltd., 1939.) 10*s*.

IN spite of the dislocation of the work of scientific and learned societies by the War, the publishers state in their preface to this useful reference book that they hope to continue to produce it. Indeed, in view of present difficulties, it is a matter for congratulation that the book has appeared so promptly, and that no increase has been made in the price. The volume is slightly larger than last year's issue, and contains the usual information relating to the addresses, publications and other activities of scientific and learned institutions, including such official bodies as the Department of Scientific and Industrial Research. In many cases the bodies referred to will no doubt have war-time addresses, but it may be assumed that correspondence addressed to their permanent homes will eventually reach them.

The Theory and Practice of General Science

By H S. Shelton. Pp. 123. (London: Thomas Murby and Co., 1939.) 3*s* 6*d*. net.

MR. SHELTON'S book is written chiefly in support of a detailed syllabus of general science, which he has arranged in the form of topics, and it may be said at once that the syllabus is a good one. He himself seems to be in no doubt about it, for he writes: "To those who desire to found a course of general science, it can be said quite simply and clearly: Here it is for the first time in a simple, intelligible and coherent form". Mr. Shelton is severely critical of all other syllabuses of general science, especially those which have recently been compiled by the Science Masters' Association. He seems, however, to have misunderstood their aim, which was not to mark the end of thought, but to display a content of teaching material which masters could employ in arranging their own schemes of work For this purpose, the form in which the S M A. printed its material is more useful than Mr. Shelton's, since it can be adapted more easily to special circumstances

Outlines of the History of Architecture

Part 4 Modern Architecture, with particular reference to the United States. By Prof. Rexford Newcomb. Pp xv+318 (New York. John Wiley and Sons, Inc., London: Chapman and Hall, Ltd, 1939.) 20*s* net

IN the history of architecture class at the University of Illinois, Prof. Rexford Newcomb found it necessary to devise means whereby both lecturer and students could make full use of their opportunities In these courses, which are largely presented by the illustrated lecture method, the students were compelled to write almost continuously in a darkened room, and much of the consequent distraction from the subject itself was obviated by supplying them with mimeographed sheets giving bibliographies, references, class assignments and directions—in fact, all the routine notes the writing down of which has no exercise value. From these sheets this very unusual book has been developed, and the author has done well to preserve and publish the valuable digest of the facts and examples on which his lectures were based. The fourth volume of the series is concerned with modern architecture—say from the beginning of the eighteenth century—and while American architecture is more freely referred to, historical, bibliographic and other data are collated from France, Great Britain, Germany, the Low Countries and Scandinavia.

Physics

Electricity and Magnetism

An Introduction to the Mathematical Theory By Prof. John B. Whitehead (Electrical Engineering Texts.) Pp xi + 221 (New York and London: McGraw-Hill Book Co, Inc, 1939) 19s 9d.

THE professor of electrical engineering of the Johns Hopkins University has written a compact introduction to electricity and magnetism in which stress is laid on the physical and mathematical theories The historical order is adopted, and the first six chapters are concerned with electrostatics. A single chapter on magnetism is followed by chapters on electrodynamics and electromagnetism, and the electrical units receive special attention The chapters on alternating currents are of value and deserve mention, as they include an elementary account of modern methods of computation Finally, a brief description is given of the theory of conduction in gases To condense so much into little more than two hundred pages is a noteworthy feat, and the author is to be congratulated on his presentation of the subject

Matter, Motion and Electricity

A Modern Approach to General Physics By Henry De Wolf Smyth and Prof Charles Wilbur Ufford Pp xiii + 648 (New York and London · McGraw-Hill Book Co, Inc, 1939) 25s.

UNIVERSITY teachers of physics who are not fettered by examination requirements and can plan their own courses will find this stimulating volume suggestive and helpful Designed for a first-year course at Princeton, the book does not profess to cover the whole range of physics, but it deals with subjects related to the great theme of atomic and molecular constitution It will therefore appeal to the chemist as well as to the eager student who wishes to plunge at once into the latest results of modern research on the properties of matter and of electricity The advantages of the practical electrical units are so great that the authors have been led to adopt from the outset the M K S (metre-kilogram-second) system of units

Cosmic Rays

Three Lectures, being the revision of the 1936 Page-Barbour Lectures of the University of Virginia and the 1937 John Joly Lectures of Trinity College, Dublin. By R. A Millikan Pp viii + 134 + 22 plates (Cambridge At the University Press, 1939) 8s 6d net.

THE first and perhaps the most important lecture is of a general character, in which, together with an account of the historical development of the subject, Millikan provides an answer to the often recurring question What good are cosmic rays? He discusses the supreme social importance of abstract scientific knowledge, first in its applications to everyday life, although these may be delayed for generations, secondly in providing the example of a network of established fact to such subjects as economics, politics, etc.

The second lecture is an account of the various particles—positive and negative electrons, protons, photons and mesotrons, and of their discovery. It is noteworthy that throughout the book there is no mention of the instability of the mesotron, nor except in a footnote of its theoretical importance.

The last and longest lecture is a study of the latitude effects, both at sea-level and high in the atmosphere It is valuable in giving in one place a full account of all the work of Millikan and his collaborators in this field, but is somewhat confusing reading, especially to those unfamiliar with the subject, as the historical development is given in detail All the misconceptions, difficulties and mistakes of the past are treated with equal emphasis as the extent of our present knowledge.

Psychology

General Psychology

By J P Guilford Pp. xii + 630. (London · Chapman and Hall, Ltd, 1939.) 18s net

THIS book is divided into six parts. The first contains a discussion, on traditional lines, of the scope of the subject and a brief outline of the nervous system A thorough and highly satisfactory section follows dealing with sensory activities and the processes of attention. The chapters on vision and hearing are noteworthy. The remainder of the book deals with the following topics: motivation of behaviour; acquiring new adjustments; symbolic activity, that is, images, concepts and language; and individual differences in ability and personality. The weakest chapters are those on human personality, which do not reach the standard set by the rest of the work

The book is designed as an introductory experimental text, and each chapter concludes with a series of questions planned to test the student's grasp of the chapter There are numerous diagrams and graphs, and the material is presented with clarity and simplicity. The student of psychology in Great Britain will welcome this interesting and up-to-date exposition of his subject

The Mind of the Bees

By Julien Françon Translated by H. Eltringham. Pp xi + 146. (London: Methuen and Co, Ltd., 1939.) 6s net

THIS little book is a reliable translation of "L'Esprit des Abeilles," the author of which is an original investigator and a good observer His work has been carried out on foraging bees and not on bees within the hive He appears, however, to under-estimate the importance played of odours in bee-behaviour, and claims that the first-comer communicates the location of a food source to the other foragers, who are thus enabled to find it. These and many other observations are carried out in a scientific manner, but the deductions made therefrom are more open to criticism. In spite of whatever defects the book may have, it is suggestive and well worth reading.

Garden, London. In it Maxim used the force of the explosion to work the breech mechanism, and for the first time produced a fully automatic gun. The Maxim Gun Company was formed in 1884 and soon it was supplying guns to many armies. In the 'nineties Maxim began his experiments with steam-driven 'captive' flying machines, on which he spent many thousands of pounds. He knew he was trying to achieve something thought impossible, and if he had little success he at least brought the subject of aeronautics into the limelight. Scores of distinguished men, including King Edward VII, then Prince of Wales, visited Baldwyns Park in Kent and rode on Maxim's machine.

Like Edison, Maxim had but little schooling, but became a first-class mechanic and pored over such books as Ure's "Dictionary of the Arts". In middle life a short handsome man of great strength, he was as self-reliant as Ericsson and as fruitful in ideas as Trevithick and Bessemer. Traditional views were nothing to him, and, though he made himself familiar with what others had done, he looked at every problem in his own original way. He was born in the State of Maine, U.S.A., but after his visit to Europe he made his home in England, became a naturalized British subject, and in 1901 was knighted. He died on November 24, 1916, and was buried in Norwood Cemetery.

William Smith

At a meeting of the Geological Society of London on January 17, Dr. L. R. Cox, of the British Museum (Natural History), delivered a lecture on the life and work of William Smith, the Father of English geology. The subject was chosen for two reasons, one being that this was the session of the Society nearest to the centenary of Smith's death, and the second that Dr. Cox had recently had an opportunity of studying Smith's original notes, diaries and letters, which have not hitherto been made public. These MSS. have apparently lain unexamined at Oxford for many years, presumably since the death of John Phillips, Smith's nephew, who until his death in 1874 occupied the chair of geology there. They were recently discovered in Oxford in a packing-case by Prof. J. A. Douglas, the present occupier of the chair, and through his courtesy they have since been examined systematically by Dr. Cox. They are now catalogued and housed in a specially built cabinet presented by Dr. K. S. Sandford and Mr. H. A. Sandford.

There are many gaps and obscure passages in the existing records of Smith's life, and these manuscripts throw a flood of light on the activities of this great geologist. Apart from the outstanding importance of his contributions to geological science, Smith lived during the heroic age of geology. The MSS. have therefore a more than personal interest, and should contribute materially to the history of the science during this period. The only existing biography of Smith, Phillip's "Memoirs of William Smith, LL.D.", has long been out of print and is almost unprocurable. With the new material at his disposal, there is every reason for Dr. Cox to prepare a full-dress account of the life and work of so worthy a subject, and it is to be hoped that its publication may not be unduly delayed.

Treasury Grant to Universities

It has been decided to maintain the Government Grant to the Universities and Colleges at the existing level, namely, £2,149,000. In reply to a question in the House of Commons on February 20, Sir John Simon said: "The Government are fully conscious of the vital part played by the universities in the life of the community, and of the importance of maintaining the standards of university education as far as possible in the strained conditions of war. Moreover the universities are making an essential contribution to the national effort at the present time in supplying personnel of the educational standards necessary for many national services, as well as in affording more direct assistance to a number of Government Departments by means of particular researches, the provision of specialized technical equipment in laboratories, and in other ways. I have satisfied myself, after considering the representations of the Vice-Chancellors and the results of a survey of university finance carried out at my request by the University Grants Committee, that the maintenance during the coming financial year of the present provision is necessary if the universities are to continue to make their contribution to the national effort, and the Government therefore earnestly hope that local authorities will take similar action."

British and French Scientific Co-operation

In connexion with the recent visit of the French scientific delegation, Capt. D. F. Plugge, chairman of the Parliamentary and Science Committee, asked the Minister of Supply what arrangements had been made for regular liaison between French scientific representatives and the Advisory Council on Scientific Research and Technical Development. Mr. Burgin made the following written reply: "Regular liaison between the Advisory Council referred to and French scientific representatives is effected through the Mission Scientifique Franco-Britannique, which has a permanent Secretary resident in London, who will shortly be located in the Ministry of Supply. The Mission has contact with the whole of the French war-time scientific organization. There is, in addition, a direct link between the Ministry of Supply and the French Ministère de l'Armement, which can be used by the Advisory Council for matters relating to scientific inventions, in the form of a Ministry of Supply officer who has been appointed liaison officer in the French Ministère and will shortly take up his duties in Paris."

Physics in War

A series of public lectures on the "Background to Present-Day Problems" has been arranged in the University of Birmingham. The second lecture in this series was given by Prof. M. L. E. Oliphant, Poynting professor of physics in the University. His

subject was "Physics in War". Prof. Oliphant stressed the value of academic science, which in present circumstances can be turned to practical use Future development of industry depends on the academic development of science, which in Great Britain is conducted only in the universities. It is therefore essential that the country should encourage academic research in science if we are to keep any sort of supremacy in industry So far, the War has been almost entirely a physicists' war, waged with weapons depending for their operation on knowledge gained by physicists

Prof Oliphant referred to the great value of the pioneer work done by Dr Lanchester in aviation, to the work of Sir William Bragg and Lord Rutherford on the detection of submarines, and to the development of the high-class optical industry. 'Wireless' is proving to be the fundamental controlling factor in the present War, and perhaps, when it is over, the public will realize how great is the work done by physicists in this field The control of the magnetic mine presents no difficulties to the physicist Scientific and technical men sometimes complain that they have not been given any job, and that their talents are not being used Some of this criticism is justified, Prof Oliphant said, because in England there is a tendency to allow administrative offices to be filled only by persons with non-technical qualifications. He deplored the conclusion that is sometimes reached that because a man has technical qualifications he cannot discharge administrative duties

Censoring Scientific Journals

IT is announced that, at the request of Sir Walter Monckton, director-general of the Press and Censorship Bureau, Sir William Bragg, as president of the Royal Society, has undertaken the formation of a scientific panel to assist the bureau in arranging the censorship of papers in scientific journals. The following have agreed to serve on the panel: Prof C R Harington (biochemistry), Prof V. H Blackman (botany and agriculture), Prof A C Egerton (chemistry), Dr H L Guy (engineering sciences), Prof. P. G H Boswell (geology), Prof. S Chapman (mathematics), Dr C. H Desch (metallurgy), Dr. C. G. Darwin (physics), Prof. A V Hill (physiology), Prof F C Bartlett (psychology), Prof W. W. C. Topley (bacteriology and pathology), Prof. M. Greenwood (statistics), Sir Guy Marshall (zoology).

Animals and Plants of Use to Man

THE British Museum (Natural History) is now open to the public on Saturdays and Sundays from 1 p.m until 4 p.m. A special exhibition has been arranged in the Shell Gallery to show the animal and plant sources from which some useful commodities come This is too vast a field for the exhibition to be an exhaustive one, consequently only selected exhibits, illustrating commodities which lend themselves to attractive demonstration, are shown. These include the sources of certain textiles like linen, cotton, silk and rayon; plant and animal dyes used in commerce; the colouring matter and ingredients of cosmetics; the sources of leathers and of bristles for brushes; the plants and animals which produce oil in large enough quantities for it to be valuable to mankind; and some of the uses of moulds and mushrooms. Several of the cases have a war-time interest; for example, animals of use in war, margarine, bacon pigs, pests of stored food. The object of the exhibition is to show the sources of certain commodities, and not to give a detailed explanation with examples of how the raw materials are worked up into the finished products

Discovery of a Royal Tomb in Egypt

A FURTHER discovery reported from San-el Hagar, the ancient Tanis, in the Nile Delta, promises results of even greater interest than those anticipated from the examination of the remarkable gold and silver sarcophagus discovered on this site by Prof. E. Montet, of the University of Strasbourg, in March of last year (see NATURE, 143, 512 and 552). When Prof. Montet returned to Egypt about a month ago to reopen his season's work on the tombs of the Twenty-first and Twenty-second Dynasties on this site, he proposed to examine the sarcophagus which had been left unopened The cartouche of Pharaoh Psussenes, identified with Sheshonk, had led to the attribution of the sarcophagus to that monarch; but in the course of the work of further examination, another tomb, it is reported (*The Times*, February 20) has been brought to light, which is thought to be the royal tomb, while the gold and silver sarcophagus is now said to be that of a royal priest. The newly discovered tomb contains a huge granite sarcophagus and a profusion of funerary ornaments These consist for the most part of gold vessels, and include a gold cup in the form of a lotus, which is said to be of great beauty This is the first royal tomb of the period (c 1100-1000 B.C.) to be discovered; and it is of enhanced importance as belonging to a phase of Egyptian dynastic history of which archæologically too little is known.

Statistical Methods and Ethnographical Observations

A NUMBER of attempts have been made from time to time to introduce statistical methods of analysis in the study of ethnographical facts, but certain obvious difficulties, more especially the artificial abstraction and the divorce of so complex an entity as an ethnographical fact from its cultural context, as a rule have militated against extended and continued application of these methods. Anthropologists, therefore, have watched with considerable interest the work of the Culture Element Survey of Native North-West America of the University of California, of which Prof. A. L. Kroeber is director. This survey was initiated as a result of an attempt to apply statistical methods of analysis to the recorded ethnographical data concerning the Indians of California by S. Klimek, who went to the University in 1933 as a Rockefeller Fellow.

The Survey has now become the most considerable example extant of the application of statistical technique to ethnographical observation. Prof.

Kroeber, in a progress report covering the work of the Survey to April, 1939 (*Anthropological Records*, 1 : 7, Culture Element Distributions, 11, 1939, University of California Press), records that between 1934 and 1938 twenty trips to indigenous groups of peoples were made by 13 different observers, who brought back 279 filled-in lists of elements. In these there are now at least half a million of particularized and localized items of cultural fact, or if the supplemental notes are included, the number may well be nearer a million. Although several monographs already have been published, the great bulk of this material awaits computation Not only does this task seem beyond human capability as a practical method of comparative ethnographic study, but also Prof. Kroeber now records that experience in the field, as well as in the study, counsels a reversal of method, at least to a major degree, in a return to the observational records of the more orthodox ethnographer

Anglo Soviet Journal

THIS new journal has been started with the purpose of supplying "the more scientifically skilled and specialized workers in the British Commonwealth with a regular flow of information, accurate and reliable, on the progress and developments that are being realized in the U S S.R , in their own field, the field which they understand best". Very wisely the first issue is largely devoted to accounts of exhibitions, particularly of the great Agricultural Exhibition held in Moscow last summer, which was unquestionably the most magnificent effort of its kind the world has ever seen. Dictatorships are based on propaganda, and the Russians are the acknowledged leaders of the world in this new art. The design of the Exhibition was coherent and logical · the products of each region were brought together into separate pavilions, and each of the chief products had also its own special arrangements for show. The architecture was impressive and striking : no one could possibly forget the huge statue at the gate or the tower just inside, or the beauty of some of the pavilions.

The visitors included parties of peasants, some in picturesque local costume from all parts of the Union ; many of them saw their own photographs hung up as good workers who had achieved more labour days than their fellows. More attention was paid to records than to average performances Special notice was given to the effort of two farm workers, Okhota and Chalova, in getting forty-one tons of sugar beet per acre (the average for England and Wales is about ten tons). How far the Exhibition reflects actual performance in the countryside cannot be determined, as no detailed statistics of yield or total production have been published so far as we know since 1935, though there are some figures for the bumper year of 1937 : but that is not the question. A forecast is given of the results anticipated from the proposed Trans-Volga irrigation scheme which, if it matures, and is free from too much complication of water-logging and salt, should produce food in a region where but little is grown now.

France's Colonial Problems

IN an address on "The Establishment of an Imperial Economy" (*Bull. Soc d'Encouragement pour l'Industrie Nationale*, October 1939), M. E. du Vivier de Streel discusses the dependence of France on her colonial resources. He stresses the importance of science and technology in colonial development and the necessity of placing larger resources at the disposal of scientific organizations and technical men for the investigation of colonial problems, whether in improvement of agriculture, the prevention or control of disease, or the opening up of mineral resources Such work should not be left precariously at the mercy of any local drive for economy M du Vivier de Streel refers also to the importance of population questions, education and a policy of public works, but while covering briefly much the same ground as the "African Survey" of Lord Hailey, he makes no reference to that outstanding work

Studentship for Psychical Research

TRINITY COLLEGE, Cambridge, has established a studentship for the study of psychical research, out of a bequest left to the College for that purpose by Mr F D Perrott as a memorial to F W H Myers. Psychical research is defined, for this purpose, as "the investigation of mental or physical phenomena which seem *prima facie* to suggest (*a*) the existence of supernormal powers of cognition or action in human beings in their present life, or (*b*) the persistence of the human mind after bodily death". The studentship is open to any person who shall have completed his or her twenty-first year at the time when the election takes place The studentship is tenable for one year, but a student may be re-elected once, but not more than once. The studentship will be of such value, not exceeding £300, as the electors may award after considering the nature of the research which the candidate proposes to undertake. Further information can be obtained from Prof. C D. Broad, Trinity College, Cambridge.

January Earthquakes Registered at Kew

DURING January 1940 thirteen earthquakes were well registered by the seismographs at Kew Observatory The largest of these were on January 6 at 14h 23m. 2s. and January 17 at 1h. 33m. 24s., though a doubtful phase preceded this at 29m 35s This latter shock was registered at De Bilt (Holland) at 33m. 16s. G.C.T , and the shock of January 26 was also well observed there. The United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentre of the earthquake of January 6 to have been lat. 22° S., long. 170° E. with initial time 14h. 3·4m. G.C.T. This determination was based on observations of seismograms obtained at Georgetown, Sitka, Apia, Honolulu, Pasadena, Fordham, San Juan and Manila. The provisional epicentre was in a well-known seismic zone of the Pacific Ocean to the east of the island of New Caledonia. The earthquake of January 17 was found by the same authority on the basis of

reports from nineteen observatories to have been provisionally centred at lat. 17° N., long. 148° E., and to have had initial time 1h. 14m. 53s. G.C.T This epicentre was in the Pacific Ocean to the east of Zealandia Bank (Marianas Islands).

The Night Sky in March

THE time of the spring equinox is March 20 18h when the sun enters the sign Aries The moon is new on March 9 and full on March 23 Lunar conjunctions with the planets occur as follows · March 11d. 8h., Jupiter 12d 14h., Saturn 12d 23h., Venus. 14d 0h, Mars. It will be seen from these times that the grouping of the bright planets is still a conspicuous feature of the western sky after sunset, although Jupiter is being lost to view as the month proceeds On March 8d 14h, Venus is in conjunction with Saturn, and on March 26d. 14h. with Uranus Mars is in conjunction with Uranus on March 16 Neptune is in opposition on March 14, the distance from the earth being 2,716 million miles. The constellations of bright stars associated with winter evenings are now well westwards when the sky darkens after sunset The regions of the sky which follows- Leo, Virgo, Ursa Major and Bootes—though less spectacular to the unaided eye, are of great interest on account of the rich fields of extra-galactic nebulæ With small or moderate optical aid, there is also a number of interesting double stars well worth examining, including Castor (separation of components 3 6″), γ Leonis (4·0″), ξ Ursæ Majoris (1·7″), γ Virginis (5 7″), ζ Ursæ Majoris (14″) and ζ Herculis (1·1″). The last binary has a period of about 35 years and was discovered in 1782 by Sir William Herschel, the greatest separation of its components is 1½″ Under favourable conditions the Zodiacal Light may be seen after sunset during this month. On fine evenings when the moon is absent, it is also worth while looking for auroras, for in March occurs one of the semi-yearly peaks in auroræ frequency. [All times are given in Universal Time; subtract 1 hour from Summer Time]

Announcements

THE University of Oxford has decided to confer the honorary degree of D.Sc on Dr. E V. Appleton, formerly Wheatstone professor of physics at King's College, London, and Jacksonian professor of natural philosophy in the University of Cambridge. Dr. Appleton is now secretary of the Department of Scientific and Industrial Research.

PROF A. L. MELLANBY will deliver the Thomas Lowe Gray Lecture of the Institution of Mechanical Engineers on March 15, at 6 p.m. The title of the lecture will be "Fifty Years of Marine Engineering".

THE Herbert Jackson Prize for 1939 of the L.M.S. Railway has been awarded to Mr. H I. Andrews, of the Engineering Section, Research Department, Derby, for his paper entitled "The Development of a Refrigerating Machine for Use on Trains".

THE council of the Institution of Naval Architects has awarded the Premium of the Institution for the year 1939 to Mr. A. Nicholls, for his paper "The All-Welded Hull Construction of H.M.S. *Seagull*. The Wakeham Prize for 1939 has been awarded to Mr. A Emerson, for his paper "The Effect of Shape of Bow on Ship Resistance (Part 2)".

DR WARFIELD T LONGCOPE, Baltimore, has been elected president of the board of directors of the Rockefeller Institute of Medical Research in succession to the late Dr Charles R. Stockard.

THE Alfred Denker Foundation Prize for 1939 has been awarded by the German Otorhinolaryngological Society to Dr. Lotar v. Hofmann, of Vienna, for a work on the influence of diseases of the ear and upper respiratory tract on the development of the infant and young child.

THE Committee of the Physiological Society which was planning the Seventeenth International Congress of Physiology at Oxford in August 1941 under the presidency of Sir Charles Sherrington has decided, with regret, that the Congress must be postponed Arrangements for the future will be made in consultation with the Permanent International Committee.

THE Central Association for Mental Welfare, in co-operation with the University Extension and Tutorial Classes Council, will, if sufficient applications are received, hold a course on mental deficiency at the London School of Hygiene, Keppel Street, W.C 1, from April 8 to 20. The lecturers will include Dr. A. F. Tredgold, Dr. Henry Herd and Miss Lucy Fildes Further information can be obtained from Miss Evelyn Fox, c/o University Extension Department, at the School of Hygiene.

A RESEARCH scholarship of the value of £250 a year and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a committee of the Institution of Naval Architects, and it is hoped to make the first award in September 1940. Full particulars of entry, which closes on July 31, can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

A PRIZE of £20 with a diploma is awarded annually by the Council of the Royal Asiatic Society for an essay on some selected subject. The object is to encourage interest in the history and civilization of the East among non-Asiatics. In order to increase the basis of interest, the Council has decided to offer alternative subjects for the next competition. The two subjects are: (i) "Compare briefly the British, French and Dutch Systems of Administration in the East"; (ii) "The Development of Modern Turkish Literature". An essay on either subject may be submitted, and must be in the hands of the secretary at 74 Grosvenor Street, W., by October 1 next.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

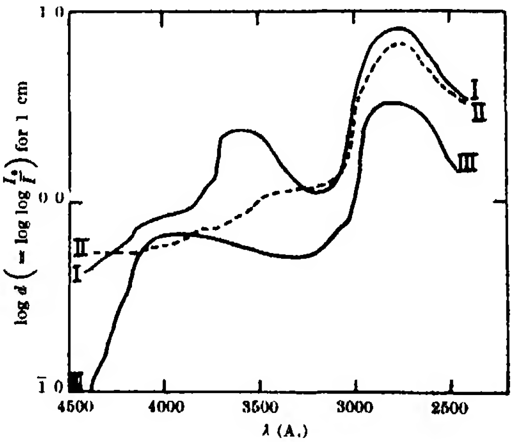
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 308. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Photo-Oxides of Carcinogenic Hydrocarbons

IN a recent note under the above title[1], Prof. J W Cook described a number of water-insoluble peroxidic photo-oxides derived from carcinogenic hydrocarbons. Experiments made in Cambridge during the past year indicate that a photochemical oxidation product, which is different in character both from those prepared by Cook and from the alkali-soluble materials prepared by Boyland, can be obtained from 3 : 4-benzpyrene under suitable conditions 10 c.c of a 0·1 per cent solution of the hydrocarbon in benzene (B D H., 'Specially Pure') is irradiated for one hour in an open Petri dish placed three inches below a neon-sensitized mercury lamp of the type described by Melville[2], nearly all the energy radiated from which is concentrated in the 2536 A resonance line The remaining benzene is quickly evaporated off in a current of air, and the dry residue is extracted with 10 c.c. of glass-distilled water or with weak alkali ($M./500$ $NaHCO_3$) and filtered The resulting solution is colourless—unlike the solid residue—and its absorption spectrum, I, contains two very well-defined bands, with maxima of intensity at about 3600 A and 2760 A respectively When the aqueous solution is allowed to stand, the band at 3600 A. disappears, while that at 2760 A becomes less intense, in the course of 3–4 hours, II The spectrum is not of the dihydroanthracene type such as is that, for example, of the water-soluble endosuccinate derivative of 1 · 2 : 5 : 6-dibenzanthracene. It indicates, however, that a labile water-soluble photo-oxidation product can be prepared from 3 : 4-benzpyrene, even though this compound gives no photo-oxide of the peroxidic type. Schulman and Rideal[3] have shown that the labile constituent of the aqueous solution can be adsorbed readily on to protein monolayers. These observations may be correlated and compared with the experiments on the photodynamic activity of the hydrocarbons described by Mottram[4].

Benzene, irradiated under identical conditions, yields a small quantity of an oily residue which dissolves freely in water to give a clear yellow-coloured solution. The absorption spectrum of this solution, III, also contains a well-defined band at 2760 A.; but this is now associated with a very wide band the maximum of which is at about 3950 A., and the absorption curve passes through a *minimum* at 3600 A. This material cannot be identified with any of the usual impurities in benzene. The same result was obtained with highly purified specimens (i) obtained from the Bureau d'Etalons Physico-Chimiques in Brussels; (ii) prepared by the method described by Lowry and Allsopp[5]; and (iii) from B D.H, 'Specially Pure', as used for the irradiation of 3 : 4-benzpyrene

In preliminary experiments, embryonic chick heart has been grown for two passages (4–6 days) in a medium composed of fowl plasma and chick embryo extract to which had been added either (*a*) the aqueous extract from irradiated 3 : 4-benzpyrene, or (*b*) the aqueous extract from irradiated benzene. A high percentage of the mitotic cells in series (*a*) was abnormal, and prophase was prolonged, as compared with control cultures or with series (*b*).



(I am indebted to Dr. A. Glucksmann for making the cytological examination of these cultures.) It is concluded that the labile product from 3 : 4-benzpyrene may have high biological activity, and experiments to isolate the substance, to elucidate its chemical and biological nature and to determine the part played by the benzene solvent in its production, are in progress.

I am also indebted to Prof. E. K. Rideal and to Dr. H. B. Fell for much valuable advice and assistance.

C. B. ALLSOPP.
University Department of Colloid Science
and Strangeways Research Laboratory,
Cambridge.
Jan. 29.

[1] Cook, J W., Martin, R., and Roe, E M. F., NATURE, 143, 1020 (1939)
[2] Melville, H W., *Trans Farad Soc.*, 32, 1525 (1936).
[3] Schulman, J., and Rideal, E. K., NATURE, 144, 100 (1939).
[4] Mottram, J. C., and Doniach, I., *Lancet*, 1156 (1938).
[5] Lowry, T. M., and Allsopp, C. B, *Proc. Roy. Soc.*, A, 133, 48 (1931)

Some Properties of Laccase from the Latex of Lacquer Trees

WE have previously shown[1] that laccase, the oxidizing enzyme present in the latex of the Indo-Chinese lacquer tree (*Rhus succedanea*), is a copper-protein compound. Our purest preparation of this enzyme, which catalyses the oxidation of polyphenols and diamines, contained 0·154 per cent copper and 6·45 per cent nitrogen, corresponding to about 45 per cent protein. The remaining fraction of the preparation was composed of a polysaccharide. This preparation had a strong blue colour which disappeared reversibly on the addition of reducing substances or substrates and irreversibly on heating the enzyme to about 60° C. or acidifying it.

It was, however, impossible to ascertain whether this deep blue colour was due to a special combination between the copper and the enzyme protein or to a colouring substance present in our preparations.

In order to determine the relationship between the colour and the enzyme we have made an attempt to obtain and study this enzyme from other sources such as the latexes of the Japanese and Burmese lacquer trees (*Rhus vernicifera* and *Melanorrhœa usitata*). As a result of this study we are now able to state that the laccases obtained from all three sources are copper-protein compounds and that the blue colour of all these enzyme preparations is not due to the copper but to the presence in these preparations of a blue pigment, the nature of which is under investigation. Although we have been unable to obtain an active enzyme preparation free from the blue pigment, the latter can be easily obtained completely free of copper and protein but always mixed with carbohydrates. The pigment preparation separated from the enzyme can be reversibly reduced to its leuco compound and irreversibly decolorized by strong acids and by boiling. The facts that the blue pigment of an active enzyme preparation is much more sensitive to acids and to heating than the free pigment, and that a colourless enzyme preparation could not be obtained, suggest the possibility that the pigment is in some way connected with the normal activity of the enzyme. It is, however, impossible to say without further study of the problem whether the pigment is intimately bound to the enzyme molecule as an additional prosthetic group or is bound to a carbohydrate and acts as a carrier between the enzyme and certain substrates. The purest laccase preparation we have so far obtained contains 0·24 per cent copper and is still of a deep blue colour.

Although laccase shows a very wide range of activity, extending to a great variety of *ortho*- and *para*-phenols, diamines and aminophenols, it does not catalyse the oxidation of monophenols such as *p*-cresol. This peculiar property of laccase preparations suggested at first that these preparations are devoid of an additional factor essential for this reaction and present in crude extracts of mushrooms or potatoes. It was, however, a matter of some surprise to us to find that the addition of such crude extracts to laccase preparation not only fails to reactivate it in relation to *p*-cresol, but also that the crude extract itself in presence of laccase loses its ability to catalyse the oxidation of this monophenol.

This peculiar inhibitory property of laccase preparations can only be ascribed to laccase itself and not to some additional factor present in the preparation. In fact, this property is not affected by dialysis, it is absent in blue pigment preparations devoid of laccase and it disappears from laccase preparation on boiling or after any other treatment which destroys the enzyme.

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Inactivation of Prolactin by Treatment with Phenyl *Iso*cyanate

PHENYL ureido derivatives of serum albumin peptone[1], plastein[2], and native proteins[3], have been prepared by treatment with phenyl *iso*cyanate. This reaction is eminently suitable for masking the free amino groups of protein molecules without doing further damage, since the reaction conditions are very mild (0° C. and *p*H 8). Hopkins and Wormall[3] concluded that phenyl *iso*cyanate reacts only with the free amino groups of the lysine components of the protein molecules.

In view of reports that prolactin, the anterior pituitary hormone which stimulates the pigeon crop-gland, can be inactivated by acetylation with ketene[4], and treatment with nitrous acid[5], we were led to compare the crop-stimulating activity of prolactin with that of its phenyl ureido derivative.

Phenyl ureido prolactin was prepared by treating a solution of purified prolactin from ox pituitary with phenyl *iso*cyanate at *p*H 8 and 0°, diphenyl urea from excess phenyl *iso*cyanate being removed by centrifuging. The pigeon crop-gland stimulating activities of this and a control solution were estimated by Rowlands'[6] systemic method.

Test liquid	No. of birds	No. of daily injections	Volume injected (ml.)	Mean crop wt. × 100 / body wt.
Prolactin	9	6	1	1·12
Phenyl ureido prolactin	10	6	1	0·45

The results in the accompanying table show that destruction of the free amino groups by reaction with phenyl *iso*cyanate has resulted in a very marked loss of activity. The percentage inhibition (see Folley[7]) was approximately 87. The observations of Evans and his co-workers[4,5], that the crop-stimulating activity of prolactin depends on the presence in the molecule of free amino groups, appear therefore to be confirmed. These experiments are being continued.

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Hyperprothrombinæmia During Pregnancy

THE determination of prothrombin in blood plasma acquired especial importance after the discovery[1] of vitamin K, which is known to play a certain part in the formation of prothrombin. During my researches on the normal and pathological variations of prothrombin I have found the concentration of prothrombin in pregnant women to be remarkably high, a condition not formerly known

The determination of prothrombin in plasma has been carried out according to a method recently indicated by me[2] My method differs from those of others in that the prothrombin is determined in relation to a standard prothrombin solution. It has proved justifiable to take the blood plasma of the investigator as a standard solution By means of this method the prothrombin values of 104 normal persons of both sexes have been determined If the average value is put at 100, the distribution has been found to range from 82 to 118 with a standard deviation of 6·58

The results of the determinations of prothrombin in pregnant women are seen in the accompanying table The figures indicate the average prothrombin value in the women examined

Month of pregnancy	Number of subjects	Average prothrombin value
1 2	7	105
2 3	8	111
3–4	7	123
4-5	5	136
5-6	4	149
6 7	7	146
7–8	5	152
8 9	27	169

It is apparent from this table that the average prothrombin values of all pregnant women examined after the third month of pregnancy are considerably higher than the average value of the normal material and exceed the highest values observed in the latter The figures indicate a steady rise from the third month until the end of pregnancy.

One month after delivery, normal prothrombin values are found

The significance of hyperprothrombinæmia in pregnant women will be further elaborated in a forthcoming publication.

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Interferometric Serum Test for Cancer

A PRACTICAL optical test of the blood serum that appears to prove of assistance in the early diagnosis and prognosis of cancer is here described, the validity of which has been ascertained in a few hundred clinical cases.

The test involves the measurement of the densities of a certain number of samples of the person's blood serum, by the use of an interferometer. The density to be determined is the result of interaction between an extract of cancer cells and the serum under examination.

Previous studies leading up to the test were those of Dr. Ernest Freund and G. Kaminer[1], F Neuberg and A. Waterman[2], further refined by Drs. R Willheim and K Stern[3]. The first four investigators claimed to have established the following facts: A lysis of cancer cells takes place in the blood serum of non-cancerous persons Serum of cancerous persons has not only no lytic substance but even a substance which protects cancer cells from destruction.

Willheim and Stern, however, stated that a diagnosis of carcinoma could not be made merely by determining the presence or absence of any specific cancer-destroying substance They postulated the existence of cancer-destroying and cancer-protecting chemical principles in the serum, the difference in the balance of which determined whether or not a serum could be clinically associated with carcinoma

It seemed that a surer and simpler diagnostic reaction should be obtained by using an extract of human cancer cells instead of the whole cells. An alcoholic extract of carcinoma of the breast, because of its convenience of freedom from infection, was prepared to serve as the testing agent Four test tubes are set up Into each of these is pipetted the same amount of cancer extract, 0 05 c.c. Next, the serum to be tested is added in each tube in increasing amounts, 0·05, 0 25, 0 5 and 1·0 c c respectively Thus four grades of dilution of the extract with the serum are established The tubes are then incubated at 37° C for 12 hours Serum is then added to the first three tubes until the level is the same as for the fourth test tube All tubes are carefully shaken and allowed to settle in a refrigerator for six hours.

Interferometer readings are made to obtain the densities of the four dilutions of the extract with the serum The pattern of the readings plotted out graphically shows a characteristic difference between the cancerous and non-cancerous sera

Compared with the pattern of the four interferometric readings of normal serum, that of the cancerous serum shows a 'disturbed balance' between the cancer-lytic and cancer-protective properties.

A cancer curve slowly changes to a normal curve after successful operation It changes again from a normal to a cancer curve in the earliest stages of recurrence A cancer curve does not change post-operatively if metastases have already taken place or are about to take place elsewhere in the body.

The test reaction failed to appear when serum of a pregnant woman or of a person with tuberculosis, syphilis or numerous other diseases was used. However, as was to be expected, fever and intensive X-ray treatments influenced the serum so as to make the test uncertain. Extract of normal organs, for example, fibroid tissue, failed to show any reaction.

This preliminary report deals with 325 cancer cases in which the test was proved to be 96 per cent correct Altogether 575 cases have been tested

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[1] Freund and Kaminer, *Wiener Klin. Woch*, 24, 378 (1910).
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A Vacuum Core-Sampler for Deep-Sea Sediments

FEW geophysical problems have such important bearings as that of sampling undisturbed sediment cores of great length from ocean deeps. Questions pertaining to the permanence of ocean basins or their subsidence, to continental drift, to climatic changes and to variations in volcanic activity, etc., can best be answered through studies of the stratigraphy of deep-sea sediments, sampled in the manner just indicated. Recently, Dr. Piggot of the Carnegie Institution of Washington has obtained cores from the north-west Atlantic bottom approaching 3 m. in length, by projecting the sampler into the sediment by means of an explosive charge.

According to a scheme advanced by one of us at the meeting of the International Council in 1933, the hydrostatic pressure prevailing at great depths has been utilized for forcing a tube-sampler down into the sediment. The first instrument, constructed during last summer in the workshop of this Institute and put to practical tests in the fall of the same year, consisted of a 2 m. length of steel tubing, 2 in. wide, closed at its upper end and having a water-tight piston at its lower end, released by trigger action as soon as it touched the sediment surface. The air was pumped out of the tube before immersion, so that the piston, followed by a column of sediment, was able to move up to the upper end without compressing any air behind it, which might otherwise expand and push out the core on hauling up the sampler to the surface. The tests made with this first sampler proved the release to function well, and the tube was filled with sediment; but at depths exceeding 150 m. the shock due to the impact from the piston proved too severe for the steel bolts securing the lid to the upper end of the tube. Moreover, the looser kinds of sediments were sucked into the tube, before it had time to descend completely into the sediment.

A modified instrument was accordingly constructed with a cylindrical container of much wider bore attached to the upper end of the tube. The container is evacuated, whereas the tube itself is completely filled with water which, after the release, is free to enter the container through a nozzle of a more or less narrow bore, according to the depth in which the sample is to be taken. Thus the rate at which the tube sinks into the sediment can be made practically equal to the rate at which the sediment core mounts into the tube. Tests with this new sampler made at depths down to 240 m. have been entirely successful, cores of lengths varying between 160 cm. and 200 cm. being readily obtained. Markings on the outside of the tube proved the sampler to have sunk into the sediment to a depth agreeing to within a few centimetres with the length of the core. A deep-sea sampler with a larger spherical container and a tube 6 metres in length is now being constructed and gives hope of obtaining cores of approximately the same length from depths of 4,000 m. or more.

With all types of samplers hitherto used, including that of Dr. Piggot, the friction against the inside of the tube prevents cores of equal length to the depth of immersion in the sediment being sampled (see Pratje's recent experiences in the Baltic). With the vacuum sampler this friction is counteracted by suction, properly regulated, so that the core will give a true picture of the undisturbed stratification of the sediment. Moreover, since the force pressing the tube down into the sediment increases with the bore of the tube, and with the depth of water, it should be possible to obtain cores of still greater thickness and length, say 10 m. if not even more, by means of this sampler. The instrument will be described in greater detail in a coming issue of *Meddelanden från Oceanografiska Institutet i Göteborg*.

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The α, β Transformation of Quartz

SIR C. V. Raman and T. M. K. Nedungadi have discussed in NATURE of January 27 a remarkable series of photographs showing the spectrum of monochromatic light scattered in a quartz crystal at various temperatures up to 530° C., not far from the transition point at 575° C. Their results are of special interest to me because they serve to confirm my opinion that, at any transition temperature (including the melting point), some kind of resonance occurs between two frequencies which characterize the two phases concerned. In other words, the transition takes place when there is close agreement between a frequency characteristic of the first phase and another frequency characteristic of the second phase. Since resonance may occur when this agreement is not quite exact, an explanation is possible of the fact that for many substances the 'setting' point is not quite the same as the 'fusion' point.

In the experiments on quartz, the authors state that "the 220 cm.$^{-1}$ line behaves in an exceptional way, spreading out greatly towards the exciting line and becoming a weak diffuse band as the transition temperature is approached. On the other hand, the other intense lines [including 132 and 468 cm.$^{-1}$] having both larger and smaller frequency shifts continue to be easily visible, though appreciably broadened and displaced". They infer that the binding forces corresponding to the line 220 cm.$^{-1}$ diminish rapidly with rising temperature, and also that the increasing excitation of this particular mode of vibration and the resulting deformation of the atomic arrangement are in a special measure responsible for the changes in the physical properties of the crystal, as well as for inducing the transformation from the α to the β form.

So far as I am aware, there is no information available as to the characteristic frequency of β-quartz save that which is obtainable from the Sutherland-Lindemann formula

$$\nu = \frac{3\cdot 08 \times 10^{12}}{V^{1/3}} \sqrt{\frac{T}{M}},$$

where T is the absolute temperature of the melting point, M is the molecular weight, and V is the molecular volume. Assuming that T is 2,053° K., and the density is 2·65, the calculated frequency is $3\cdot 63 \times 10^{12}$ sec.$^{-1}$, corresponding to 212 cm.$^{-1}$, and thus supports the hypothesis put forward.

For some time I have been examining the effect of substituting the absolute value of a transition point for T in the melting point formula, and have obtained interesting results. Taking 848° K as the transformation temperature of α, β-quartz, the corresponding frequency is $4 \cdot 09 \times 10^{12}$ sec.$^{-1}$ or 136 cm.$^{-1}$. This is very nearly the same as the Raman line 132 cm^{-1}.

The two suggestions which I wish to emphasize are these: (1) the occurrence of a transformation is associated with some kind of resonance between approximately equal frequencies characteristic of the phases concerned; (2) the applicability of the Sutherland-Lindemann melting point formula to the transition point.

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Chemical Action of γ-Radiation from ^{80}Br

DURING the course of an investigation into the exchange of radiobromine between a number of organic and inorganic bromides, it has been observed that with certain of the latter, for example, aluminium bromide, and a wide variety of organic bromides, a complete exchange of all the bromine atoms in the system takes place very quickly at room temperature With many other inorganic bromides, however, there is apparently no exchange, but an *extraction* of the 18-min. ^{80}Br isotope from the radioactive organic bromide.

For example, if inactive antimony tribromide be dissolved in radioactive ethyl bromide several hours after the preparation of the latter, that is, when all the 18-min. isotope originally present has decayed, and immediately after the dissolution the ethyl bromide be volatilized away *in vacuo*, the residue of antimony tribromide is found to be strongly radioactive, with a half life of 18 min., the 4·5- and 36-hour periods being found in the condensed ethyl bromide.

That is, the antimony tribromide has made a selective extraction of the short-lived radiobromine isomer which has grown from, and is in transient equilibrium with, the parent 4·5-hour ^{80}Br. This result is to be attributed to a form of intramolecular photo-dissociation of the ethyl bromide by the internal conversion of the γ-ray which, as Snell[1], Abelson[2] and others have shown, is emitted by the bromine nucleus during the isomeric transition. A similar extraction was observed with arsenic tribromide, phosphorus pentabromide and, though the amount extracted was less, with crystals of mercuric bromide and of potassium bromide, and with metallic silver, mercury and even gold. In each case the radiobromine extracted was almost pure 18-min. ^{80}Br, the 'tail' to the decay curve due to the longer-lived isotopes being very small—generally less than 1 per cent of the total initial activity.

Segré, Halford and Seaborg[3] obtained a partial separation of the radiobromine isotopes by the precipitation of silver bromide from an aqueous methyl alcoholic solution of radioactive *tert*-butyl bromide, and DeVault and Libby[4] obtained a more complete separation by the precipitation of silver bromide from a radioactive bromate solution. These authors attributed the separation to a chemical activation of the molecule containing the bromine, by the recoil from an internal conversion electron. LeRoux, Lu and Sugden[5] have also found that a greater proportion of the 18-min. isomer than of the 4·5-hour isomer can be extracted by aniline from neutron irradiated ethylene dibromide, or by water from a benzene solution of a radioactive alkyl bromide, and offer as explanation[6] that the soft γ-ray gives a recoil which can only activate, but not disrupt, the C–Br bond

The present results indicate, however, at all events in the case of ethyl bromide, that the process is not simply a matter of supplying an extra activation energy (over that received spontaneously by thermal agitation) to an otherwise exothermic reaction, since the removal of a bromine atom or ion from an ethyl bromide molecule by arsenic tribromide or mercuric bromide, for example, is endothermic by a very large amount.

Moreover, the mechanical recoil of the bromine nucleus from the γ-ray or from a conversion electron cannot be a major factor in these reactions. Siday[7] has shown that the energy of this γ-ray emitted during the transition is about 43,000 e.v. The energy of recoil of the comparatively heavy bromine nucleus from such a γ-ray is about 286 cal./mol., which is less than the energy of thermal agitation of the molecule at room temperature The internal conversion of this γ-ray results in the expulsion of conversion electrons, the recoil from which will be greater than from the γ-ray, but even with 100 per cent efficiency of recoil would be less than 7 kcal./mol. Such an additional energy would accelerate the hydrolysis of an alkyl bromide, but could not bring about the present results. These suggest that a bromine atom or ion is broken completely away from the ethyl bromide molecule before reaction, a process requiring about 60 kcal./mol. if the disruption is into neutral fragments, and rather more for disruption into ions (much of the additional energy required to form the ions is recovered as solvation energy when the process takes place in solution).

It appears more probable, therefore, that the C–Br bond is broken immediately following the nuclear transition, not by mechanical recoil of the bromine atom, but by a process involving any one of a series of excited molecular states which are produced during the gradual settling down of the bromine atom after the start of the internal conversion. That is, the molecule is broken up, not merely activated, by a process which is more in the nature of a photo-dissociation brought about by intramolecular quanta.

All these reactions were carried out with anhydrous materials at room temperature, the ethyl bromide being volatilized away *in vacuo* ($\sim 10^{-3}$ mm. mercury), at or below room temperature and condensed by liquid air. The radiobromine was converted into AgBr, the activity of which was measured with a Lauritsen type quartz fibre electroscope.

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Effect of Temperature on Lubricant Films

THE friction apparatus developed by Bowden and Leben[1,2] has shown that when clean steel surfaces slide on one another, the motion is not smooth but proceeds in a series of irregular jerks. This apparatus has also been used for comparing the lubricating properties of various substances. With the high loads and low speeds employed, the conditions which obtain correspond to boundary lubrication. Experiments show that when a non-polar lubricant such as medicinal paraffin oil is used, the motion still proceeds in stick-slips, though the average value of the friction is lower than for the dry surfaces. Certain long-chain fatty acids and small quantities of these acids in a non-polar oil will, however, cause continuous sliding[1,3]. This property has been used to detect the oxidation of non-polar oils on heating. The original oil gives a jerky motion; when a certain amount of oxidation has occurred the motion becomes smooth. The rate of this oxidation becomes appreciable with most oils at temperatures above 150° C. and the change in the frictional behaviour is irreversible on subsequent cooling[3].

Some recent work on commercial oils giving smooth sliding on steel surfaces at room temperature has revealed a new effect. As the surface is warmed (to temperatures usually ranging between 40° C. and 80° C.) stick-slips set in, which increase in size with temperature and decrease as the temperature is reduced. Provided the heating has not been sufficient to cause appreciable oxidation of the lubricant, this effect is reversible. Subsidiary experiments have shown that it is not due to any change of viscosity with temperature, and the effect is to be attributed to a desorption or disorientation of the lubricant film. These results indicate that *in those cases where boundary lubrication occurs*, a lubricant which behaves well at room temperature (that is, which gives smooth sliding) may have poor lubricating properties at quite moderate temperatures of the running parts. The temperature at which this reversible effect occurs will be a measure of the strength with which the lubricant film adheres to the surface; the higher the temperature the more strongly is the film adsorbed on the surface. It is possible by such means to compare different lubricants in this respect.

Experiments have also been carried out with pure fatty acids, and similar effects have been observed, though the temperature at which stick-slips commence is appreciably higher than the values given above and increases slightly with the chain length of the acid.

These observations are of importance in any general consideration of the effect of temperature on the behaviour of adsorbed films.

I am indebted to the Asiatic Petroleum Company for permission to publish this work, which was carried out in their laboratories.

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Points from Foregoing Letters

C. B. Allsopp has found that photo-oxidation products of 3 : 4-benzpyrene, which can be extracted with water or dilute alkali, possess characteristic absorption spectra. The unstable extracted material, which was shown by Schulman and Rideal to react strongly with protein monolayers, is found to produce a high percentage of abnormal mitotic cells in embryonic chick heart tissue cultures.

After examining the oxidizing enzymes, named laccases, obtained from the latex of the Indo-Chinese, Japanese and Burmese lacquer trees, D. Keilin and T. Mann conclude that they are all copper-protein compounds containing a blue pigment the nature of which is under investigation.

A. C. Bottomley and S. J. Folley find that the pigeon crop stimulating activity of the anterior pituitary hormone prolactin disappears when the free amino groups react with phenyl *iso*cyanate.

O. Thordarson finds that the prothrombin content of the blood plasma of pregnant women is higher than normal. A steady rise occurs from the third month of pregnancy until delivery; normal values are found again one month after delivery.

It is claimed by M. W. Mettenleiter that the density of blood serum incubated with an alcoholic extract of carcinoma of the breast, can be used as a test for cancer. When the observations are plotted, a characteristic difference between cancerous and non-cancerous sera is observed; this difference disappears after successful treatment and reappears with recurrence. The test fails in cases of pregnancy and of certain diseases.

The experimental results of Raman and Nedungadi on the α, β transformation of quartz are reviewed by Prof H. S. Allen. Two suggestions are put forward: (1) at any transition temperature (including the melting point) some kind of resonance occurs between two approximately equal frequencies characteristic of the phases concerned; (2) the Sutherland-Lindemann melting point formula may be applied to the transition point.

Experiments on the exchange of radiobromine between organic and inorganic bromides are described by F. Fairbrother. The radiobromine with a half-life of 18 min. can be separated almost completely from the others by extraction of a radioactive organic bromide with certain inorganic bromides and metals. Since the energy of mechanical recoil, from the γ-ray emitted during the isomeric transition of ^{80}Br, or from its conversion electrons, is too small to break the C–Br bond or to bring about the observed reactions, these are attributed to a fission of the bond by an intramolecular photo-dissociation.

Using the stick-slip friction apparatus developed by Bowden and Leben, D. Tabor finds that certain lubricants giving smooth sliding on steel at room temperature give stick-slip motion when heated to moderate temperatures. This effect is reversible with temperature and has been observed with pure fatty acids. It is attributed to a desorption or disorientation of the lubricant film.

RESEARCH ITEMS

Facial Deformity in Anthropomorphic Pottery

IT is pointed out by R. N. Salaman that in any considerable collection of Chimu Peruvian pottery there will be found among the anthropomorphic pots examples in which some peculiar deformity of mouth or nose or both occur (*J. Roy. Anthrop. Inst.*, 69, 1; 1939). Several different explanations have been put forward. Distinct groups may be recognized, namely, those which depict abnormal localized obesity, those in which the face is distorted as a result of facial paralysis, and those in which the mutilation is induced and associated with some representation, however conventionalized, of the potato. The potato was regarded as controlled by a spirit which was strengthened by blood libations effected by the act of mutilation. This mutilation consisted in the abscission of the upper lip, and often the lower as well and the removal of the soft parts of the nose. The effect was a startling display of teeth and a cavernous mouth, the explanation being that the Peruvians regarded a potato eye as a mouth, which indeed it resembles in the Peruvian varieties more closely than an eye. A pot of the proto-Chimu period from Chimbote shows the symbolism complete. It depicts a human figure built up from a single potato tuber, in which the end of the nose and the central portion of the upper lip are removed, while on the body are displayed potato eyes from each of which are growing several slender sprouts. In the left hand the figure holds a digging stick. A large number of the pots for funerary purposes exhibit facial deformities which might be illustrative of some disease process, such as, it is suggested, the *uta* disease due to an infection with the protozoan *Leishmania brasiliensis* in various stages, after surgical treatment and after death. The reason or reasons underlying the frequent representation by the ancient Peruvians of maimed and mutilated figures remain obscure.

Moulting in Snakes

A SHORT paper by Robert M. Stabler, reporting upon twenty-one snakes observed for periods ranging from 11 to 47 months, adds to the somewhat meagre knowledge about this habit (*Copeia*, 227; 1939). The snakes belonged to seven different genera and fourteen species, and yet they showed similarity in the frequency of sloughing when account was taken of the periods of reduced activity, and when observations were confined to individuals which fed readily and were perfectly healthy. Continuous observations showed apparent dissimilarity; thus in 47 months one specimen of *Agkistrodon piscivorus* sloughed fifteen times, while another sloughed three times in 12 months, and one individual of *Elaphe o. obsoleta* only twice in 12 months, the average periods between sloughs in these cases being respectively, 3·1, 4, and 6 months. But all the snakes were kept in a room not specially heated, and it was found that when winter temperatures fell as low as 40° F. a state of pseudo-hibernation or 'rest period', was induced, during which the snakes lay motionless for days, took food sparingly, and sloughed rarely. This period, extending from about October to April, averaged 6·4 months in the year. When the rest periods, which were carefully recorded, were omitted from the computation, the sloughing in the three cases mentioned took place respectively at intervals of 1 3, 2 3, and 1·2 months. In all the snakes the periods were somewhat similar, generally ranging around about 1 5 months.

Translocation in the Somatic Tissue

L. V. MORGAN reports the finding of two salivary gland nuclei with a reciprocal translocation between the right arms of chromosome 2 and of chromosome 3 of *Drosophila melanogaster* (*Genetics*, 24, 747–752; 1940). The interchange must have occurred in the last or in a very late division in the nucleus of a somatic cell before the full number of cells of the salivary gland was attained. The discovery is of importance in showing that reciprocal translocations, like mutation, or crossing-over, may occur during mitosis as well as during meiosis.

Genetical Investigation in Neurospora

Neurospora tetrasperma normally has four spores per ascus, and differs in this respect from *Neurospora sitophylla*, which forms eight spores per ascus. One culture of *N. tetrasperma* was found by B. O. Dodge (*J. Hered.*, 30, 467–474; 1939) to form ascocarps which contained aborting and sterile asci. About 10 per cent of the ascocarps occasionally contained a fertile ascus, with usually eight not four ascospores. If these eight spores were cultured, those that germinate again produced 4-spored asci On the other hand, a binuclear spore sometimes found in an ascus would give aborting ascocarps with an occasional 8-spored ascus, as in the original culture. It would seem that this culture of *N. tetrasperma* produced eight spores, half of which carry *E*, a lethal which prevents germination. As a result of segregation at the second division for both sex factors, *Aa* and the lethal *Ee*, a large spore may contain *AE* and *ae* in the two nuclei, and can germinate and give rise to ascocarps. Many of these will abort, but some will contain 8-spored asci, since *E* affects the nuclear distribution and spindle mechanism at spore formation

Separation of Amino-Acids in Protein Digests

AN interesting new method of protein analysis is outlined by R. L. M. Synge (*Biochem. J.*, 33, 1913, 1918, 1924 and 1931; 1939). The amino-acids in a digest are acetylated and then extracted with chloroform in a continuous liquid extractor. The partition coefficients of these acetylated amino-acids between chloroform and water vary so widely that separation into groups is readily accomplished, for example, acetyl-1-phenylalanine is soluble and *N* acetyl-1-hydroxyproline almost insoluble in chloroform. Subsequent benzoylation of hydroxy groups, however, produces derivatives easily soluble in chloroform such as *N*-acetyl-*O*-benzoyl-1-hydroxyproline and hydroxy-amino-acids can thus be readily separated from other amino-acids. Fractionation of hydroxyamino-acids from each other may be carried out by preparing their *N*-acetyl-*O*-methyl derivatives, which have very different chloroform-water partition coefficients.

Solvent Effect on Solubility

THE solubilities of barium iodate, silver acetate and silver sulphate in dioxane-water mixtures at 25° over the complete range of solvent mixtures have been determined by T. W. Davis, J. E. Ricci and C. G. Sauter (*J. Amer. Chem. Soc.*, 61, 3274; 1939). This corresponds with a variation of dielectric constant of 2·10 to 78·55 (the widest so far reported in solubility work), and the results have been treated in the light of the interionic attraction theory and Born's theory of solvent interaction, in which the free energy of charging spheres of radius r in a medium of dielectric constant D is set equal to $Z^2e^2/2Dr$, where Z is the ionic valency and e the charge on the electron. This equation, even when corrected for interionic effects, fails to account for the variation of solubility with solvent, the predicted solubility in each case being too low. An empirical result, that the mean activity coefficient of an electrolyte in saturated solution is almost independent of the dielectric constant of the medium, is pointed out. The test of the Born equation applied was to determine whether the value of a, the effective ionic diameter, remained constant from one medium to another and was related to the solubility and dielectric constant according to an equation made up by combining Born's equation with the Debye-Huckel equation containing the simple correction for ionic diameter. This was not found to be the case. The questions of a changing with solvent and incomplete ionization of solute (for example, with barium iodate) are to some extent considered by the authors, but not the use of a more accurate equation for activity coefficients than the Debye-Huckel equation.

Chaulmoogra Oils

CHAULMOOGRA is the native name of the oil expressed from the seeds of the fruit of the *Taraktogenos kurzii*, and it has been used for centuries in Burma and India in the treatment of leprosy. The tree is widely distributed in Burma and is also found in Thailand (Siam), eastern Bengal and Assam. The gathering of the seeds is dangerous on account of wild animals, and as the fruit is no longer fresh when gathered the oil is of poor quality and is often adulterated. The name 'chaulmoogra' is also applied to any oil containing chaulmoogric acid, such as *Hydnocarpus wightiana* and *H. anthelmintica*. The latter occurs abundantly in Thailand, Cambodia, Cochin China and Laos, and has been successfully cultivated in Hawaii and the Belgian Congo; its seeds form an article of export to China, where they are known as Ta-fung-chi or Ta-feng-tzu. *T. kurzii* has also been acclimatized to Brazil. H. I. Cole and H. T. Cardoso (*J. Amer. Chem. Soc.*, 61, 3442; 1939) find that chaulmoogra oil (from *T. kurzii*) keeps for years if expressed from dried fresh seeds and not from old seeds, and is non-irritating upon injection. They give the first quantitative analyses of oils from *H. anthelmintica* and *T. kurzii*, finding that they contain hydnocarpic, chaulmoogric, gorlic, oleic and palmitic acids as well as small amounts of lower homologues of hydnocarpic acid. They also give the physical and analytical characteristics of five chaulmoogra oils. One of these (from *O. echinata*) contained no hydnocarpic acid but was very rich in chaulmoogric acid. The true chaulmoogra oil contained the highest percentage of gorlic acid.

Prehistoric Copper

AT a meeting of the Newcomen Society held at the Iron and Steel Institute on February 14, Mr. H. H. Coghlan read a paper on "Prehistoric Copper and Some Experiments in Smelting". Native copper, he said, occurs as thin plates, or in massive form in crevices in the rocks. The latter form is very intractable to work, and it was the former that prehistoric man used for making such things as needles, awls, beads and chisels. These were made by cold-working. As to the discovery of the processes of tempering, melting and smelting, Mr. Coghlan thought that at some early date, say about 5000 B.C., small objects were made by hammering; then when tempering was discovered and understood, larger objects were made, followed by, first, the discovery of smelting, and then of melting. The discovery of the process of smelting from ore must have been accidental. Some thought it was due to ore melting in a camp fire. To test this theory, the author made experiments trying to reproduce the conditions likely to have obtained, but the result was negative. Taking the green carbonate malachite, he had subjected it to the heat of a charcoal fire, but all he obtained was black oxide of copper. The result led him to try smelting the ore in an arrangement in which the conditions were such as existed in the ancient pottery kiln, and in this experiment he obtained metallic copper in the form of well-shaped crystals. Mr. Coghlan concluded by discussing the problem of how malachite may have been used in connexion with pottery.

Constants of the Star-Streams

W. M. Smart and T. R. Tannahill have utilized the photographic proper motions of 18,323 stars in the zone $-40°$ to $-52°$ for the determination of the constants of the star-streams (*Mon. Not. Roy. Astro. Soc.*, 100, 1; November 1939). The results of the analysis according to the two-stream theory are as follows:

	Drift i	Drift ii
R.A. of apex	88·0° ± 1·4°	303·6° ± 9·5°
Dec. of apex	−8·5 ± 0·6	−75·0 ± 13·5
Space velocities of drifts	1·463 ± 0·035	0·650 ± 0·035

The probable errors are small in the case of Drift i but they are not very satisfactory in the case of Drift ii. The vertex of the star-streaming is R.A. 271·5° ± 1·6°, Dec. −14·5° ± 2·0°, or, in galactic co-ordinates, long. 343·2° ± 1·0°, lat. −0·5° ± 1·7°. The vertex derived from the Cape proper motions is seen to lie on the galactic equatorial plane, but the longitude exceeds that derived by other methods by 16°, though it is almost exactly the same as Jackson's value. The equatorial co-ordinates of the solar apex are R.A. 265·1°, Dec. +26·1°; solar speed 0·879 astronomical unit. From the values of the stream-constants the ellipsoidal constants are calculated, and the results are compared with those obtained by Jackson from his analysis of the proper motions according to the ellipsoidal hypothesis. Those obtained by the first method are $G_0 = 334·6° \pm 1·2°$, $K/H = 0·705 \pm 0·002$, and the corresponding values found by Jackson are 343·6° and 0·59°; G_0 denotes the longitude of the vertex and K/H is the ratio of the minor axis to the major axis of the velocity ellipsoid. The authors show that a very close agreement between the two values derived by such dissimilar methods is not to be expected.

GLUTAMIC ACID OF PROTEINS

THE recent claim of Kögl and Erxleben[1] that the proteins of malignant tissues are partially racemized was based largely on the observation that the hydrolysates of such proteins, unlike those derived from normal tissues, contained glutamic acid which showed evidence of racemization, in some cases to a high degree. In our preliminary communication[2] we directed attention to the fact that we had been able to isolate the normal, unracemized, *l* (+) glutamic acid hydrochloride in good yield from three different samples of malignant tissue protein material, and suggested that a more extensive investigation was needed before Kögl and Erxleben's claim could be admitted. In reply, these latter workers[3], *inter alia*, produced evidence which they believed to show that our modified Foreman[4] method of analysis was unsuitable for demonstrating the presence of any racemized glutamic acid in protein hydrolysates, because the calcium salt of this acid is more soluble in 90 per cent alcohol than is that of the natural *l* (+) antipode, and also because the racemic hydrochloride is more soluble in either concentrated or 20 per cent hydrochloric acid than is that of the natural product.

Our own investigations have now led us to conclusions that are still at variance with those of Kögl and Erxleben, and a paper giving full details of our work has been submitted for publication in the *Biochemical Journal*. The points to which we wish to direct attention in this communication are as follow:

(1) The calcium salts of both the racemic and the *l* (+) glutamic acids are equally insoluble in 90 per cent alcohol, and the fact that our modified Foreman method of analysis is applicable to hydrolysates containing large amounts of the racemic acid follows from the data for the wheat protein gliadin given in the accompanying table.

Protein material	Method of analysis	Glutamic acid isolated: Yield as per cent of protein	Glutamic acid isolated: Percentage racemisation	Yield of $d(-)$ glutamic acid as per cent of protein
Normal ox heart	Foreman	11·93	2 7	0 16
Normal calf lung	Foreman	8 70	1 8	0 08
Grafted sarcomata from mice	Foreman	8·34	2·7	0 11
Metastases from liver of a woman with carcinoma of colon (E.B.)	Foreman	10·28	4	0 22
Metastases from liver of a man with carcinoma of bronchus (W.V.)	Foreman	10 25	2 8	0·165
"	Cuprous oxide First crop	0·44	63·4	0·14
	Second crop	2·39	1	—
Gliadin	Direct as hydrochloride,	33·53	nil	—
	followed by Foreman analysis	9·55	46	2·21

(2) When the method is applied to hydrolysates containing only a small amount of the racemized acid, the first two or three crops of hydrochloride isolated will consist almost exclusively of the *l* (+) antipode, and it is necessary to search the mother liquors to obtain evidence for the racemized product. What we believe to be well-nigh quantitative glutamic acid analyses of three malignant tumour and of two normal tissue protein preparations are given in the table. In all five cases the yield of total glutamic acid is high, but that of the unnatural *d* (−) antipode is very low, and there is no apparent differentiation between the two types of tissues. It is clear from these results that our failure to demonstrate the presence of the racemized acid in our earlier tumour analyses was due to the fact that the natural *l* (+) antipode was present in large excess.

(3) The above-mentioned results are not in keeping with those of Kögl and Erxleben. The latter workers, using the Dakin butyl alcohol procedure, have in two instances isolated products showing a high degree (80 per cent; 89 per cent) of racemization in yields that indicate 4·16 per cent and 3·69 per cent respectively of the *d* (−) antipode in terms of protein material taken for analysis. Nevertheless, in the majority of their analyses they have used the shorter, cuprous oxide, method of Abderhalden and Fuchs[5], and whereas from normal tissue materials the products isolated in yields of from 1·65 per cent to 5·0 per cent showed the normal rotation, those obtained from malignant tumour materials, in yields sometimes as low as 0·34 per cent, always showed a high degree of racemization (20–85 per cent). Because they had shown that the hydrochloride of the racemic acid was more soluble in concentrated hydrochloric acid than that of the natural antipode, they have assumed that the glutamic acid they failed to isolate from the hydrolysate would be racemized to at least the same degree, and have accordingly interpreted their results as showing the presence of the *d* (−) antipode in amounts comparable with those obtained from the two samples of malignant tissue mentioned above.

That this is not a valid interpretation follows from the results given in the table, which show that under the conditions of these cuprous oxide analyses the racemic glutamic acid hydrochloride may be preferentially salted out, even when the *l* (+) glutamic acid is present in very large excess. In the case quoted, the first crop by the cuprous oxide procedure, obtained in only 0·44 per cent yield, showed 63·4 per cent racemization, yet the companion Foreman analysis, which gave an overall yield of 10·25 per cent, showed only 2·8 per cent racemization.

These findings explain the apparently conflicting results recorded in the recent literature[6] and show that the interpretation of Kögl and Erxleben's cuprous oxide analyses must be based on the *yield* of the product isolated and not on its *percentage racemization*. A review of their data on this basis suggests that, except in three cases, the amount of *d* (−) glutamic acid present in the various malignant tumour hydrolysates was of the same order (0·5 per cent) as we ourselves have obtained from both malignant and normal tissue material, and much less than we have obtained from seed proteins, such as gliadin and edestin. We have, moreover, isolated

partially racemized aspartic acid from the hydrolysates of both types of animal tissue protein, and are thus led to conclude that racemization of amino acids is not a characteristic of malignancy.

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[1] Kögl and Erxleben, Z. physiol. Chem., 258, 57 (1939).
[2] Chibnall, Rees, Tristram, Williams and Boyland, NATURE, 144, 71 (1939).
[3] Kögl and Erxleben, Z. physiol. Chem., 261, 154 (1939); Kögl and Erxleben, NATURE, 144, 111 (1939); Kögl, Erxleben and Akkerman, Z. physiol. Chem., 261, 141 (1939).
[4] Foreman, Biochem. J., 8, 463 (1914).
[5] Abderhalden and Fuchs, Z. physiol. Chem., 57, 339 (1908).
[6] Arnow and Opsahl, Science, 90, 257 (1939); Graff, J. Biol. Chem., 130, 13 (1939); White and White, J. Biol. Chem., 130, 435 (1939).

IN 1939, Kögl and Erxleben[1] reported the isolation from tumour proteins of amino-acids of the *d*-series, chiefly *d*-glutamic acid, and developed a new theory of the origin of malignant tumours based on the view that malignant growth depends upon the alteration of the proteins in tumour cells owing to the inclusion of racemized amino-acids. Chibnall *et al.*[2] failed to detect the unnatural form of glutamic acid in hydrolysates from tumour proteins. Graff[3] was also unable to reproduce Kögl's results. According to Kögl[4], the failure of these authors to obtain *d*-glutamic acid was due to the fact that they used a different method for its isolation. White and White[5] and Arnow[6] confirmed the results of Kögl in a small number of experiments, but Dittmar[7], who followed Kögl's technique for the isolation of glutamic acid, failed to detect the *d*-form of this acid in proteins from the growing parts of different types of sarcoma, though he was able to establish racemization of glutamic acid in the proteins from necrotic malignant tissue.

I have isolated glutamic acid from normal and malignant tissues by the method described by Kögl, due notice being taken of the technical details stated in his second paper. The experimental results are summarized in the accompanying table. As seen from these data, partial racemization of glutamic acid has been observed in a few cases in malignant tumours. In the majority of the tumours, however, no 'unnatural' glutamic acid was present. The extent of the possible loss of the *d*-form in the course of the isolation procedure was ascertained in an experiment in which 100 mgm. racemic glutamic acid were added to the hydrolysate from 5 gm. of dry muscle proteins. From this material 670 mgm. glutamic acid were obtained, with an amino nitrogen content of 7·51 per cent and 27·5° specific rotation. Thus 42·8 mgm. have been recovered from the 50 mgm. of *d*-glutamic acid added to the muscle protein hydrolysate. Further, we have recrystallized from 20 per cent hydrochloric acid 200 mgm. of a glutamic acid mixture with $[\alpha]_D = +24°$ made from 150 mgm. *d*-acid and 50 mgm. of the racemate. Upon recrystallization we obtained 174 mgm. glutamic acid with $[\alpha]_D = +25°$. These values show that the percentage of *d*-form lost in the course of isolation and purification of glutamic acid from protein hydrolysates by Kögl's method is low.

Our experimental data justify the conclusion that the presence of $d(-)$ glutamic acid in tumour proteins is not a regular phenomenon attending malignant growth. Our present aim is to investigate the causes of the presence of *d*-glutamic acid in the hydrolysates from certain tumours. The data at our disposal for the present give no reason to associate this phenomenon with bacterial activity in the necrotized parts of the tumours, as suggested by Dittmar.

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[2] Chibnall, A. C., Rees, M. W., Tristram, G. R., Williams, E. F., and Boyland, E., NATURE, 144, 71 (1939).
[3] Graff, J. Biol. Chem., 130, 13 (1939).
[4] Kögl, F., Erxleben, H., and Akkermann, A., Z. physiol. Chem., 261, 141 (1939).
[5] White, I., and White, M., J. Biol. Chem., 130, 435 (1939).
[6] Arnow and Opsahl, Science, 90, 257 (1939).
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GLUTAMIC ACID FROM NORMAL AND MALIGNANT TISSUES

Source of tissue	$[\alpha]_D$	Amino-nitrogen (per cent)	Weight of hydrolysed material (gm.)	Amount of isolated glutamic acid (mgm.)	Notes
Normal rabbit's muscle	+ 31·50°	7·51	—	—	
,, ,, blood	+ 31·0	7·31	—	—	
Muscle from rabbit affected with Brown-Pearce carcinoma	+ 31·0	7·3	—	—	
Blood from rabbit affected with Brown-Pearce carcinoma	+ 31·8	7·76	—	—	
Brown-Pearce carcinoma	+ 26·5	7·67	67	180	No visible necrosis
,, ,, ,,	+ 31·0	7·8	63	215	,, ,, ,,
,, ,, ,,	+ 31·5	7·31	60	185	,, ,, ,,
,, ,, ,,	+ 31·0	7·4	62	335	Slight necrosis
Rous chicken sarcoma	+ 27·0	7·31	28	90	No visible necrosis
Krichevsky-Sinelnikow rat sarcoma	+ 31·5	7·34	40	150	,, ,, ,,
Methylcholanthrene sarcoma (rat)	+ 22·0	7·53	30	130	,, ,, ,,
,, ,, ,,	+ 31·5	7·45	26	98	,, ,, ,,
Liver of rats painted with *o*-amino-azotoluene	+ 31·5	7·6	—	—	

RELEVANT to the discussion which has taken place recently between Chibnall[1] and Kögl and Erxleben[2,3] are some facts which I have accumulated in an analysis of gliadin. Kögl and Erxleben find that the glutamic acid derived from the proteins of malignant tissue is partially racemized and suggest that this might be a characteristic of such proteins. Chibnall found tumour proteins to contain the bulk of their

glutamic acid in the ordinary active form with $[\alpha]_D + 31{\cdot}6°$ in 9 per cent hydrochloric acid, and he thought that any racemization was incidental to the methods employed in its isolation. The work described here indicates that a vegetable protein such as gliadin also contains part of its glutamic acid in a racemic form, and that it is probably a general characteristic of proteins and not of special significance for the proteins of tumours.

600 gm. air dry protein (91·6 gm. nitrogen) were hydrolysed for thirty-six hours with 30 per cent sulphuric acid, the acid removed with baryta, and the barium salts of the dicarboxylates precipitated by adding 3 vols. of 95 per cent alcohol. This precipitate was dissolved in dilute hydrochloric acid, freed from barium, and saturated with hydrochloric acid gas. Five crops of glutamic acid hydrochloride were precipitated, with characteristics as shown in the accompanying table.

TOTAL NITROGEN PRECIPITATED AS DICARBOXYLATES 24·6 GM.

Crop	Wt	m p	Wt as free glut acid	% N	% Cl	Rotation 4% aq soln	Gm N in fraction	m p of 3 : 5 dinitrobenzoyl deriv	Yield of deriv
1	225·0 gm	207°	181·0 gm	7·55	19·40	+ 25·0°	17·0	104	40·0%
2	15·0 gm	208°	12·1 gm	7·40	19·48	+ 20·8°	1·0	104°	40·0%
3	7·5 gm	203°	6·0 gm	7·43	19·5	+ 19·1°	0·55	104°	39·4%
4	7·0 gm	202°	5·6 gm	7·40	19·4	+ 24·0°	0·53	104	38·1%
5	3·0 gm	175°	2·4 gm	7·45	19·3	+ 5·8°	0·23	203°	51·6%
	Isolated in su	bsequent	fractions 6·0 gm				19·31 gm	104°	8·0%
							0·59 gm N	203°	58·0%

All five fractions were converted to 3 : 5 dinitrobenzoyl derivatives with the results indicated—the first four fractions yielding a derivative having m.p. 104°; the last crop a 203° m.p. derivative. Both derivatives analyse as for 3 : 5 dinitrobenzoyl glutamic acid, but the 104° derivative crystallizes with one molecule of water, whereas the 203° derivative is anhydrous.

The mother liquors from the precipitation of glutamic acid hydrochloride (4·4 gm. nitrogen) were reprecipitated with baryta and alcohol, giving a precipitate (2·34 gm. nitrogen) and a filtrate (2·02 gm. nitrogen of which 0·55 gm. nitrogen was present as NH_3). The precipitate was freed from barium, converted to copper salt to separate aspartic acid and then subjected to Dakin's treatment in order to see if any hydroxyglutamic acid was present. None was found, but the silver precipitate and the silver filtrate together yielded another 6 gm. of a glutamic acid which gave a 3 : 5 dinitrobenzoyl derivative, m.p. 203° (≡ 0·57 gm. nitrogen).

The copper aspartate which looked a homogeneous blue crystalline mass was also examined, and from it by crystallization there was obtained 2·35 gm. of glutamic acid and 2·25 gm. aspartic acid. It would thus appear as if the copper salt were a double salt of copper aspartate and copper glutamate (1 : 1), as the 4·86 gm. of amino-acid obtained from it would require to be in the ratio 2·55 gm. glutamic acid : 2·31 gm. aspartic acid. This glutamic acid also yielded a 3 : 5 dinitrobenzoyl derivative m.p. 203°.

There is thus the curious fact that the first four fractions of glutamic hydrochloride yield a 3 : 5 dinitrobenzoyl derivative which crystallizes with 1 H_2O and has m.p. 104°. Fraction 5, however, yields a derivative, crystallizing without water, m.p. 203°, and all the subsequent fractions yield the 203° m.p. derivative.

It was thought that this might be the derivative obtained from *d-l*-glutamic acid and so a sample of *l*(+)-glutamic acid was racemized by boiling a 0·4 *M*. solution in normal caustic soda for 130 hours until the specific rotation was zero. The free amino-acid was isolated, but still yielded the 3 : 5 dinitrobenzoyl derivative m.p. 104°.

It is thus not 3 : 5 dinitrobenzoyl *d-l*-glutamic acid.

The free acid is only sparingly soluble in hot water, and its equivalent weight by titration against standard baryta is 144. The copper salt is easily soluble in water and it sets to a glass on evaporation. Its rate of ring closure at *p*H 4 to form pyrrolidone-carboxylic acid is almost identical with that of known glutamic acid. On oxidation with free hypochlorous acid it yields succinic acid. All these factors confirm the belief that it is a glutamic acid.

Samples of the 3 : 5 dinitrobenzoyl compounds, m.p.'s 104° and 203°, were next hydrolysed by heating in a sealed tube at 120° for eight hours. The specific rotations determined in micro-polarimeter tubes indicated that the 104° derivative yielded an amino-acid having $[\alpha]_D$ in 9 per cent hydrochloric acid + 13·5°; whereas the 203° derivative gave an amino-acid with $[\alpha]_D - 2°$. As the rotation observed was only $-0{\cdot}14°$ in a somewhat cloudy solution, it might well be that the solution was inactive.

The amino-acids obtained by hydrolysis of the 3 : 5 dinitrobenzoyl compounds were re-benzoylated, and this time both yielded the derivative m.p. 203°.

It appears to me that the probable explanation of these facts is that the glutamic acid obtained by hydrolysis of the protein contains, besides *l*(+)-glutamic acid, some racemic glutamic acid; and as *d-l*-glutamic acid yields the derivative m.p. 104°, this racemic acid is probably not an artefact but a definite hydrolysis product. It is important to remember that this *d-l*-glutamic acid received violent treatment (boiling for 130 hours with normal sodium hydroxide) in comparison with that accorded to the natural glutamic acid. However, to complete the investigation a study of the equilibrium conditions for the reaction

$$d\text{-}l\ (\text{mixt.}) \rightleftharpoons \text{racemic (compd.)}$$

is being undertaken both for glutamic acid itself and for its 3 : 5 dinitrobenzoyl derivatives.

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[1] NATURE, 144, 71 (1939).
[2] *Z. physiol. Chem.*, [illegible], 57 (1939).
[3] NATURE, 144, 111 (1939).

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX

ANNUAL REPORT

THE Association of Special Libraries and Information Bureaux arranged to hold its sixteenth annual conference at University College, Nottingham, during September 15–18, 1939. Owing to the War, the meeting did not take place, but a report including the papers which were to have been presented together with the Council's report on the year's work of A.S.L.I.B. 1938–39 and a report of the fourteenth annual general meeting held on November 24, 1939, has now been issued*. The report indicates that the membership stands at 334 as against 325 in the previous year, and the financial position continues to restrict the activities of the Association. One hundred and eight translators are now registered, but this service is not nearly so widely used as it should be. At the annual meeting, the chairman emphasized that under war conditions the need for a clearing house for information is accentuated and the Council aims at keeping the work of the Association going as normally as possible.

Of particular interest to scientific workers are the papers dealing with "Thesis Literature" by Colonel Luxmoore Newcombe, of the National Central Library, Mr. Watson Davis and M. Julian Cain. Colonel Newcombe, dealing with the accessibility of British university thesis literature, emphasizes the need for more information about such theses, to which we have no adequate guide. The accessibility of theses for consultation or loan is discussed and some details are given of existing catalogues in university libraries and the collections of foreign theses in such libraries. Colonel Newcombe also discusses the feasibility of compiling and publishing a national guide to these theses, as well as the advisability of each university filing in its library two copies of each unpublished thesis accepted for any degree. The compilation of such a catalogue of unpublished theses in each university library, and the collection in one library, possibly the National Central Library, of copies of published foreign theses, which would be available for loan, also require consideration.

Mr. Watson Davis, in his paper dealing with the accessibility of the thesis literature of the United States, emphasizes the service which the American Documentation Institute is able to offer for obtaining American dissertations on microfilm in co-operation with the libraries and institutions concerned. M. Julian Cain's notes on thesis literature in France describe the centralization of such theses in the Library of the University of Paris (Sorbonne). A complete set is sent to each university library in France annually and to all foreign libraries participating in the exchange scheme.

A paper by G. S. Fulcher discusses the value of author's abstracts as an aid to documentation and advocates the extension of this system, preferably through some organization such as the International Federation of Documentation. Dr. L. A. Sayce contributes a paper on microphotography in 1939 in which he refers to the research work proceeding at King's College, Newcastle-on-Tyne, and the need for a central library, preferably in London, to take the lead in Britain by establishing a well-equipped micro-copying bureau

Papers of more general interest are those in which Sir Harry Lindsay describes the work of the Imperial Institute as an information centre; Mr. Guy Pocock describes the libraries and information bureau of the British Broadcasting Corporation, and Mr. Thomas Baird discusses the cinema and the information services, in which he emphasizes the important educational work the cinema could render in wartime conditions, notably in evacuation problems.

* Report of the Proceedings of the Sixteenth Conference, organized to be held at Nottingham University College, September 15th to 18th, 1939. Pp 92 (London. A S L I B, 1939) 5s

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LEVEL MEASUREMENT AND CONTROL

AN important class of instruments among those required for scientific purposes as well as for the many accurate measurements which are now an essential feature in industrial and engineering undertakings is that which is designed for indicating, recording and controlling liquid levels. Many devices have been adopted for these purposes, one being the employment of compressed air which is arranged to be slowly discharged through an open tube the end of which is submerged in the liquid. As the head of liquid above the open end varies, so does the pressure of air, thus giving an indication of the level. Instruments of this type are suitable for almost any fluid and give single or multi-point readings, or they may be adapted for continuous records. Where the provision or use of an air supply presents difficulty or is undesirable for special reasons, depth indicators and level recorders may be of the self-contained pressure bulb type. The bulb is installed at the zero of the level to be measured and is connected by tubing to the instrument, which may be at any desired height above or below the liquid and at any reasonable distance from it.

For tanks the mercury column can be conveniently employed, and a precision type of instrument based on this principle is capable of an overall accuracy of 0·005 of an inch of mercury. Instruments for level and depth alarm or control are of pneumatic or electrical types and, at maximum or minimum or both, they operate bells, klaxon horns or pilot lights to give warning or regulate a diaphragm control valve so as to maintain any desired level. The

pneumatic principle can be applied also to measure the specific gravity of liquids of variable density by two standpipes connected to a differential pressure indicator or recorder. In a list recently issued, Messrs. Negretti and Zambra, who have wide experience in the manufacture of instruments of these types among many others, have supplemented the illustrations with accessory schedules and diagrams showing how the several models are employed and connected under different conditions of service. More than a catalogue, it is thus a handbook for the reference of those responsible for the selection and installation of level measuring instruments.

THE PUBLIC HEALTH IN WAR-TIME*

IN every war of which we have records the wastage from disease has outnumbered many times the losses from killed and wounded. Figures from the War of 1914–18 support this statement, as well as the experience of the Walcheren expedition and the Crimean campaign.

Military and civil authorities are both interested in the maintenance of the public health in war-time. Military and civilian health authorities successfully co-operated in this respect during the War of 1914–18, and similar arrangements have been made in the present war.

While indirect war consequences, such as alterations in diet, excess of work and worry and the pandemic of influenza (1918–19), contributed to increased rates of mortality among civilians in the War of 1914–18, the record of civil public health was good on the whole. The population increased and the infant mortality rate was lowered. It must be remembered that that War saw the beginnings of those personal health services which have done so much to improve the health of the community; for example, the School Medical Service (1907), the Insurance Medical Service (1912), the Tuberculosis, Maternity and Child Welfare and Venereal Disease Services. It is a harder task in the present War to maintain the health services at the high level they have reached. In addition, unprecedented demands have been made on the national health services. The central health authority has become a more important arm of defence, and has had to organize an emergency medical service, in itself a stupendous task, and an evacuation scheme for school children, expectant mothers young children and other priority classes of the population.

An account of the emergency medical service and of the medical problems of the evacuation scheme was also given

Certain criticisms of the evacuation scheme were discussed. It was emphasized that the Public Health and School Medical Services should not be blamed for departures from the normal standards of cleanliness and conduct found in certain of the evacuees. The root cause of these conditions lies in the home. They mean that slum clearance has not yet gone far enough, that low standards of living still persist, and that the lessons taught in the school and clinic sometimes fail to reach the older generation.

It was suggested that the policy of preparing for casualties and of evacuation may have played no inconsiderable part in the present freedom of Great Britain from enemy air raids.

Reference was made to certain diseases—deficiency diseases, tuberculosis, venereal diseases, influenza, infectious diseases, cerebrospinal fever—which are the objects of special concern in this War. The civilian arm has yet to receive its baptism of fire. If that stern ordeal comes, it will endeavour to keep the flag of national health flying in the storm of war as zealously as it did in the sunshine of peace.

* Substance of a Chadwick Public Lecture delivered on February 20 by Sir Arthur MacNalty, K.C.B., Chief Medical Officer of the Ministry of Health.

HAULAGE PRECAUTIONS IN MINES

OF the deaths caused by haulage accidents in mines, the fact that over a period of eight years nearly 25 per cent were due to runaway tubs is sufficiently serious to indicate this as a subject demanding inquiry. One of the lines of research undertaken in this connexion was to determine the relative degree of effectiveness of the different types of backstay which are used as one means of arresting potential runaways. The backstay, which is known by several local names, is a strong steel bar which trails along the rail track at the rear of the string of tubs, its function being to dig into the track if the train tends to run back. Frequently its action is ineffective, and this led to one line of research being directed by the Department of Mines towards ascertaining the chief causes of the failures and the ways and means of preventing them by improving the design of this simple safeguard. The results of this investigation have now been published under the title "Backstays for use in Mines" (Safety in Mines Research Board Paper No. 103. H.M. Stationery Office. 1*s*. net). which describes all the steps taken and results obtained and makes available to the coal mining industry the conclusions reached.

Representative types of backstays having been obtained from several coalfields, these were examined for variations in design. They were classified in four groups, the classification mainly depending on the method of attachment to the tub. In other respects very marked differences were noted; length varied from 23 to 42 inches and weight from 9¼ to 72 lb. They were subjected to a number of tests under conditions simulating those which might actually

occur when tubs are on an incline, such as allowing tubs to run back for some feet before the stay is free to operate, or being bumped into by a runaway. The results of the several tests are recorded in relation to the four different groups of the original classification. From these it was possible to draw conclusions as to a suitable mode of attachment, safe limits of length, weight and cross-section and general construction. It is interesting to note that the ideal length is about that of the longest stay examined and its weight should be about 40 lb

The metallurgical and mechanical tests of the materials used in the sample stays showed that they have usually been made of soft steel and therefore have been relatively weak and easily bent. The report recommends that high quality steel should be used, preferably 1·5 per cent manganese steel as previously suggested for colliery haulage drawgear.

In addition to the details of the investigation, the paper gives the analysis of the problem in relation to different numbers of tubs on various inclines The formulæ published should be of considerable assistance in checking the sizes required under any given conditions

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TRANSVERSE DISTRIBUTION OF HORMONES IN PLANTS

By E. D. Brain

"THE relation between various types of hormone distribution is the internal regulating mechanism of a plant" This conception underlies the theory of the transverse reactions of plants which Georg Borgström discusses in a recent publication[1]. He emphasizes the physiological importance of transverse hormone distribution in relation to polar transport. Starting from the discovery that treatment with ethylene upset the normal transport of auxins and caused a transverse flow out of the phloem into the surrounding tissue with consequent swelling of the cells, Borgström studied various natural conditions which produced similar effects He found that light of short wave-lengths, high humidity, high and low temperature, action of specific chemical substances, mechanical stimulation of the phloem and the age of the plant organ were factors which influenced the direction of auxin distribution, by diverting the normal polar stream into transverse channels with resulting reaction in the plant. Among these "transverse reactions" of the plant he classes tropistic growth responses, the light-growth reaction, secondary growth, root formation, root contraction, water transport, fruit development and leaf fall. He also discusses various other physiological and morphological problems in the light of his theory and suggests that the transverse distribution of hormones is responsible for various ecological types; the strength of the reaction being governed by the extent to which normal growth is upset by the transverse effect

It is impossible to discuss here the numerous applications of the transverse theory, but I propose to deal with Borgström's interpretation of the mechanisms of photo- and geo-tropism, which is in some way illustrated by my own work on geotropism[2]. According to Borgström, light induces lateral hormone transport which increases the transverse growth of cells of the cortex and retards their elongation on the light side of the stem. Histological studies by various workers have endorsed this, and Borgström's measurements for cells of the cortex in Pisum stems and Lupinus and Helianthus hypocotyls, when submitted to unilateral illumination, show marked increase in width and decrease in length on the illuminated side. A transverse growth effect is therefore included in the mechanism of phototropic curvature. What has been termed as increased sensitivity in the dark can also be explained as the normal elongation proceeding without interference from transverse light effects. A study of geotropically curved stems shows increased width of cells on the lower side, accompanied by elongation due to the accumulated auxin from the transverse effect of gravity In the root the same distribution takes place but, since auxin inhibits growth, the lower side is retarded and positive curvature results. In my investigations on the growth of plants for prolonged periods on a klinostat, I have found histological changes which indicate the resultant of processes which would normally produce curvature. In hypocotyls of *Lupinus albus*, marked increase in the radial walls of the cortical cells was noted, and in radicles, cells of the cortex were much shorter in longitudinal section but only slightly smaller in transverse section It appears as if radial extension is the predominant factor in negative curvature of the stem, whereas in roots the inhibition is more in the longitudinal direction. Reaction of shoots and roots is different and it seems doubtful if the transverse effect can be so complete an explanation of positive geotropism as Borgström suggests.

Besides seedlings, flowers and leaves of *Narcissus pseudo-narcissus* and fronds of *Asplenium bulbiferum* were grown on the klinostat. In Narcissus flowers no bend in the receptacle occurs on the klinostat but, at the stage when the bud bends normally, changes occur in the outer layer of cells. The difference in length of the dorsal and ventral halves of curved flower stalks has been explained by Zollikofer[3] as being due to the unequal elastic pressure of the two halves, as a result of unequal growth hormone distribution. On the klinostat the normally unequal distribution would be equalized and alteration in the elastic pressure might result, causing the tangential stretching of cells which are compressed when bending occurs normally. It is significant that these changes coincide with a maximum development of statoliths in the receptacle, which points to the possibility of some link between the statolith apparatus and the bending mechanism.

In Narcissus leaves the epidermal cells are shorter and there is a greater number of stomates on both the inner and outer surfaces of the leaves grown on the klinostat. The cells of the cortex of *Asplenium bulbiferum* fronds are much wider radially

and shorter on the klinostat than in upright plants. On the klinostat there is less sclerenchyma formed. The walls of the sclerenchymatous cells are much thinner and the cells are half as long and more than twice as wide as in upright fronds. Heyn[4] has shown that geotropic stimulus causes changes in the plasticity of cell walls as a result of auxin redistribution. In this case the continual transverse auxin supply prevents the cells ageing and losing their plasticity, and the formation of sclerenchyma is retarded. In all cases examined, no difference was found in the distribution of starch and statoliths in plants on the klinostat. Borgström questions the idea of the statolith mechanism and geotropic reaction being causally related. He considers that it is the transverse distribution of auxin caused by gravity which increases the mobility of the starch grains and facilitates their falling, at the same time inducing differential growth of longitudinal and transverse cell walls. From experiments with onion and oat roots he shows that auxin activates diastatic processes and accelerates the transformation of starch into sugar, and he assumes that it is a transverse distribution of auxin which causes the disappearance of starch from developing tissues, making sugar available for growth purposes. Should this be so, one would expect to find that an artificially induced transverse distribution would change the distribution of starch in klinostat plants.

It is clear that a change in the direction of auxin distribution may alter the plasticity of cell walls and lead to definite changes in plant tissues. The possible applications of this theory offer wide scope to the research worker in many problems of plant physiology and morphology.

[1] Borgström, Georg, 'The Transverse Reactions of Plants. Outlines of a New Interpretation of the Significance of Growth Hormones for Life-Processes in Plants''. Pp. 230. (Lund: C. W. K. Gleerup; Copenhagen: Ejnar Munksgaard; London: Williams and Norgate, Ltd., 1939.) 6.00 kr.

[2] Brain, E. D., *New Phytol.*, **38**, 3 (1939).

[3] Zollikofer, C., *Ber. deutsch. Bot. Ges.*, **53**, 152-157 (1935).

[4] Heyn, A. N. J., *Jb. wiss. Bot.*, **79**, 753-787 (1934).

THE SCATTERING OF WAVES IN RADIO TRANSMISSION

FOR many years past, the mode of propagation of radio waves through the ionosphere has been studied intensively by mathematicians, physicists and radio communication engineers. It is now well known that all long-distance communication takes place by deflection of the waves in one or other of the ionized regions of the atmosphere, and furthermore that, depending upon the density of ionization of any particular region, there is a maximum frequency of the waves which will be deflected and above which the waves penetrate the region and are not returned to the earth. This critical penetration frequency increases with the angle of incidence of the waves on the ionosphere. Thus, while the general features of long-distance radio transmission can be interpreted in terms of a simple ray treatment of the waves passing from the earth up to the ionosphere and back to the earth, there is a minimum distance from the sending station at which signals can be received by this mode of propagation. This 'skip' zone or distance, as it is termed, is naturally subject to diurnal and seasonal variations, as well as to the actual frequency used in the transmission.

Although all normal commercial communication takes place by the transmission of waves to ranges beyond the skip zone, it has been known for some time that, inside this zone, signals may be received more or less spasmodically, these signals being very irregular and subject to large variations in both intensity and direction of arrival at the receiving station. This type of reception has been interpreted as being due to the scattering of waves from local irregular portions or clouds in the ionosphere, where the intensity of ionization is such as to give rise to a diffuse reflection of the waves in all directions.

In a paper read before the Wireless Section of the Institution of Electrical Engineers on February 7, Mr. T. L. Eckersley presented an analysis of the effect of scattering in radio transmission. The earliest experimental evidence of scattering was obtained from observations at Chelmsford in 1927, when the short-wave beam stations were first opened. In general, such scattered signals within the skip zone gave no definite bearing indication on a direction-finder unless the sending aerial emitted a directive beam, in which case the apparent direction of travel of the waves was approximately the opposite to that in which the beam of rays was projected. In later work, it has been possible to measure the time delay of the scattered signals in relation to the ground or direct ray, and also in some instances to the normal echoes received after one or two reflections from the *F* region of the ionosphere. The scattered echoes are of relatively low intensity and thus only become suitable for quantitative observation when a high-power transmitter is available, and the use of a pulse modulation makes possible the measurement of the time of arrival of the individual echoes.

Photographic records demonstrated by Mr. Eckersley showed that the scattered echoes have a moderately well-defined minimum time of arrival, but beyond this, the received echoes are spread over a considerable period in an irregular manner. A complete investigation of the phenomena showed that the cause of such scattering lies in momentary irregularities and small clouds in the *E* region of the ionosphere. Since the wave frequencies employed were generally much greater than the critical frequency of the *E* region, the path of transmission from the sender involved penetration of this region, reflection at the higher *F* region, followed by scattering from the upper side of the *E* region, and so by a second reflection from the *F* region back to the receiving station on the ground. The time delays of the echoes fits in with this explanation, and the fact that the average intensity of the scattered signals varies approximately as the fourth power of the wavelength is in accordance with the scattering coefficient of ionic clouds in the *E* region.

The effect of scattering is of major importance in the analysis of long-distance radio transmission phenomena, and the results of the investigation described in the paper referred to do much to increase our knowledge of the subject and our understanding of the mechanism by which the scattering is produced.

R. L. S-R.

SEVENTY YEARS AGO

NATURE, vol. 1, February 24, 1870

The Minister of Public Instruction

REFERENCE is made in a leading article to the Education Bill, the first reading of which was taken in the House of Commons "last week". The reception given to the Bill suggests that a Minister of Public Instruction will shortly be appointed.

"Such a Minister should, we think, take charge of the whole range of natural knowledge in all matters in which the State in any way intervenes to advance such knowledge. We understand the comprehensive term natural knowledge to include Education, Science, the Fine Arts, and Music. . . The Education branch would include the national system of compulsory primary education about to be established, public schools, universities. . . The Science branch would include all establishments, in receipt of Government assistance, in which Science is taught as a special study; all those in which scientific observations or investigations are conducted under State auspices, and all museums in which natural objects are displayed for scientific purposes. . . . The first step towards organizing this branch of knowledge must be by collecting facts and opinions relating to it This step can only be taken through the agency of a Royal Commission instructed to give the widest possible scope to its inquiries into everything relating to both Instruction and Investigation in Science"

"A DEPUTATION consisting of Earl Fortescue, the Right Hon. C. B. Adderley, Dr. Farr and others, had an interview with Mr. Shaw-Lefevre at the Board of Trade on Saturday to recommend the legislation of metric weights and measures in the Post Office, and the legal substitution of metric weights for the troy weight which the Standard Commissioners propose to abolish."

"WE have to record the decease of Mr. J. F. Sowerby, so well-known in connection with the illustration of botanical works, especially the new edition of the English Flora, edited by Mr. J. Boswell-Syme, now nearly completed"

"A METHOD of protecting iron from atmospheric influences has been proposed by Messrs. Macmillan and Macgregor, of Dumbarton and Glasgow. They bring melted sulphur into contact with the cold metallic surface to be coated. The sulphur chills and sets into a hard, thin, protecting cover"

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned

RESIDENT HEADMISTRESS of the Royal Masonic School for Girls, Rickmansworth Park—The Secretary, Royal Masonic Institution for Girls, 31 Great Queen Street, Kingsway, W C 2 (March 1)

CHIEF CHEMICAL INSPECTOR, Chemical Inspection Department, Royal Arsenal, Woolwich—The Ministry of Supply (S.E.S.B.), The Adelphi, W C 2 (quoting Appts. 021/S E S.B) (March 4)

LECTURER IN BACTERIOLOGY, Royal Veterinary College, and RESEARCH ASSISTANT in the Research Institute in Animal Pathology—The Bursar, Royal Veterinary College, The University, Reading (March 9).

HEADMISTRESS of the County School for Girls, Gravesend—W. A. Clench, Bank Chambers, Windmill Street, Gravesend (March 11).

PROFESSOR OF MECHANICAL ENGINEERING—The Secretary, The University, Birmingham (April 20).

PART-TIME TEACHER IN CHEMISTRY—The Head of the Department of Chemistry and Biology, The Polytechnic, Regent Street, W.1.

CIVILIAN WIRELESS INSTRUCTORS at the Electrical and Wireless Schools, Royal Air Force—The Under-Secretary of State (S 5.D.), Air Ministry, Adastral House, Kingsway, W.C.2.

ASSISTANT MECHANICAL ENGINEERS for the Electrical Branch, Public Works Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9067).

MECHANICAL AND ELECTRICAL ENGINEER for the Public Works Department of the Government of the Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S.W 1 (quoting M/9120).

TWO ASSISTANT ENGINEERS—The Engineer, Nene Catchment Board, Priestgate, Peterborough

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S 2.B (Met), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C 2

HEADMASTER of the Sydney Grammar School, Sydney, New South Wales—The Agent-General for New South Wales, 125 Strand, W.C.2, or The Secretary to the Trustees, Sydney Grammar School, Sydney.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Royal Commission on the Distribution of the Industrial Population. Report (Cmd 6153) Pp x+320. (London H M Stationery Office.) 5s net [62

University of Leeds. Department of Coal Gas and Fuel Industries, with Metallurgy Report of the Livesey Professor (D. T. A. Townend) for the Session 1938-39. Pp 18. (Leeds The University) [72

Mines Department Eighteenth Annual Report of the Secretary for Mines for the Year ended 31st December 1938, and the Thirty-first Annual Report of H.M. Inspector of Mines for the same Period, with a Statistical Appendix to both Reports Pp xx+271 (London H M Stationery Office.) 4s net. [72

Father and the Family. Pp 12. (London National Baby Welfare Council) 2d. [82

Mines Department Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas Pp 27+2 plates. (London H M. Stationery Office.) 9d. net [82

Tenth Annual Reports of the National Radium Trust and Radium Commission, 1938-1939 (Cmd. 6161.) Pp. 30 (London: H.M. Stationery Office.) 6d net. [92

Smoke Abatement in Wartime Pp 12. (Epsom. National Smoke Abatement Society) [92

Transactions of the Zoological Society of London Vol 24, Part 7. The Mammals of the North Cameroons Forest Area, being the Results of the Percy Sladen Expedition to the Mamfe Division of the British Cameroons By Ivan T Sanderson Pp. 623-726+22 plates (London: Longmans, Green and Co, Ltd.) 50s [122

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Smithsonian Miscellaneous Collections. Vol. 99, No. 1: Sketches by Paul Kane in the Indian Country, 1845-1848. By David I Bushnell, Jr. (Publication 3553.) Pp. ii+25. (Washington, D C.: Smithsonian Institution.) [12

Proceedings of the United States National Museum. Vol. 87, No. 3075. A Taxonomic Study of Neotropical Beetles of the Family Mordellidæ, with Descriptions of New Species By Eugene Ray Pp. 271-314. (Washington, D.C.: Government Printing Office.) [22

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Field Experiments on Sugar-Cane in Trinidad. Annual Report for 1939. By P E. Turner. (Published by the Sugar-Cane Investigation Committee) Pp 262. (Trinidad. Government Printing Office.) [62

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 204: Flax in Egypt. Part 1. Research and Culture. By Dr. M. A. El Kilany, Pp. 4+32+10 plates. P.T. 3. Bulletin No. 215: Jute and Kindred Fibres in Egypt—Research and Culture. By Dr M. A El Kilany. Pp. 6+22+12 plates. P.T. 3. (Cairo: Government Press.) [122

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Vol. 145 SATURDAY, MARCH 2, 1940 No. 3670

THE UNIVERSITIES IN WAR-TIME

THE function of the universities in relation to research needs in war-time may not be so well appreciated as other factors which at the present time are directing attention to their place in the national life of Great Britain. Like other educational institutions, their work has in many places been seriously disturbed by the exigencies of evacuation. Both research and teaching have been interrupted, and even where satisfactory and efficient arrangements have been made in the reception areas for the performance of those functions, great difficulties have frequently been met by students. These difficulties, for example, have deprived University College, London, and the London School of Economics of half their students. Although a number of evacuated university institutions are now expected to return to their normal quarters by the autumn term, there is sound reason in the appeal of the National Union of Students for a Government grant to enable students who would otherwise be deprived of their education to continue their studies.

The attempt to return to normal education and to evolve a sound and practical policy out of the muddle into which evacuation has thrown it must include university education along with the elementary and secondary stages. In contrast to 1914, the universities have indeed already been recognized by Government as institutions of national importance, both from the point of view of assisting in the War, and also of maintaining higher learning and culture. The welcome news that the Government has decided to maintain its Treasury grant at the pre-War level (see NATURE, February 24, p. 299), strengthens this conviction. In the contacts of the past year or so between the universities and the Service and other Government departments in regard to the utilization of personnel and facilities, and particularly in the sympathy and understanding which characterize this co-operation, we have evidence that the role of the universities in supplying the educated and trained leadership essential in handling the problems of a democratic society is fully appreciated by the Government.

If therefore it is admitted that universities are vital necessities in the efficient service of the needs of a democratic society, whether as an industrial nation in a world where science is the basis of power, or in the defence of its life, its liberties and traditions against the methods of modern warfare, it can scarcely be disputed that a grave responsibility must rest on the universities in the preservation of the permanent values of our ordinary life. The autonomy of government, the freedom of speech and thought and investigation which are cherished privileges of British universities, place upon them a prime responsibility to provide the informed and disciplined intelligence that alone can be adequate to meet the needs of a post-War world, to repair the breaches made in our institutions by the War, and to reconstruct those parts of our political and economic system which are shown to be defective by the War. If reconstruction is to have a practical meaning, it requires at once the trained and disciplined intelligence, the impartial and patient analysis, the imaginative insight on human issues, the sense of values and creative force which it should be a chief glory of our universities to supply.

The importance of the contribution which the universities can make to the winning of the War, to the planning of the peace and the provision of

leadership of the requisite capacity, makes it essential that the ways and means by which that contribution is made should be rigorously re-examined It is no simple problem to secure the economy that may justly be demanded, without endangering the deeper values which a university must always safeguard The Treasury grants to the universities have always recognized the right of the universities to enjoy complete freedom In war-time, that independence must be preserved at all costs Nothing is easier than for the essential liberties for which we are contending to be endangered and lost by gradual encroachment under the duress of war

Unsleeping vigilance in these matters is essential, but the universities must prove themselves worthy of that independence by the thoroughness of their response to the national need, and the ability with which they not only maintain their highest traditions but also raise the efficiency of their service. On the economic side there are things with which they can do without, and without which they will be content They will not expect the same funds for new buildings which in better times they ought to have It is not in war-time that we can expect most of our modern universities to approach nearer to the Platonic ideal that youth should be brought up "amid fair sights and sounds".

The essentials of university education must not be stinted. Municipal bodies, like the State, should continue their help at least undiminished, increasing it where those essentials are lacking or inadequately provided Even in war-time, it is a good investment for the nation to provide at the modern universities more opportunities for healthy recreation as a part of the corporate life The Physical Education Centre which the University of Manchester has recently opened is a token of the movement to make the life of the modern university more rounded and complete Behind that movement, moreover, lies the possibility of developing a system of physical education which will make the student's life happier and more efficient in the best sense ; and there is a large field for research, the knowledge garnered from which may be applied not only to university students but also to adolescents generally

Here is only one of the directions in which the universities might, even in war-time, extend their services to the community. There is also a great task in extra-mural work, which some of them are already shouldering, despite all the handicaps imposed by the black-out. Programmes of lectures are being provided for troops in the areas served by the universities in an attempt to see that the minds of those called to the colours do not stagnate or become set in Service grooves In spite, too, of the dislocation of civil life and the long hours put in on munitions, the demand for tutorial classes is strong, and the teaching normally done outside the universities on their own initiative or in collaboration with the Workers' Educational Association proceeds vigorously

The significance of this extra-mural work should not be under-rated. As Dr W. C Mitchell reminds us in his presidential address to the American Association for the Advancement of Science (see NATURE of February 10, p 207) the gravest dangers to democracy come from within, not from without The universities have a decisive part to play in dispelling ignorance and countering by critical inquiry the propaganda which turns ignorance to its uses In war as in peace, those who cherish learning must seek to foster, by all means within their power, a scientific attitude among their fellow citizens. Extra-mural work offers an invaluable opportunity of developing respect for evidence and promoting a general understanding of the methods and results of science

Important as may be the educational functions of the universities in such extra-mural fields, it is to the training given within their walls and to their functions in the advancement of knowledge and the maintenance of standards that attention is at present being most clearly directed. The pursuit of knowledge and the training of youth must indeed go hand in hand with the cherishing of human values—of personality, of freedom and truth—if a university is to make its full contribution to the enrichment of national life, above all by inspiring that deep consciousness and appreciation of the national heritage which alone can sustain the effort and sacrifices which their defence may well demand in the present struggle. Whatever resources may be available for the universities —and the importance of their contribution to our war effort and the preservation of the permanent values of our heritage may well justify expansion rather than contraction of those resources—the present position demands that they should be used as wisely and efficiently as possible.

It is from this point of view that it is imperative to re-examine the utilization of these resources and their distribution over the various functions of a university and the numerous branches of learning

which it serves. Let no one imagine that this is a simple task. The complexity of the relations between the different functions and faculties must not deter us from the task, and the gravity of the danger which threatens all alike may well be sufficient at last to initiate the effort.

In regard to the advancement of learning, the university occupies a place in the research front. If knowledge is to be available to serve the war-time needs of the nation no less than to solve the problems of peace, some means must be found of keeping an appropriate balance between fundamental and applied research, of providing for the following-up of advances in knowledge, and of diverting effort to fields neglected or holding up the general advance. All this must be done without endangering that freedom of investigation and spirit of unprejudiced quest for truth which lie at the root of all scientific advance Particularly is it important to provide for investigations in the domain of human relations, where lack of knowledge is already handicapping our war effort in many fields.

The advancement of knowledge links itself naturally with the teaching functions of the university through the thorny problem of the relation of teaching and research. Here we may well have to review the whole question of technique in the light of recent criticism and discussion on the use of the lecture or the tutorial system. Similarly, we have to consider the efficiency of research at the universities, not merely in terms of the claims of teaching, tutorial or administrative duties, but also in regard to the provision of adequate assistance or services in the laboratories, so that the best use is made of the time of qualified research workers.

These are questions which, like those of professional training, may well occupy the attention of the universities themselves and also of the many professional associations of scientific workers and their fellows. We cannot expect in the stress and strain of war to find and apply a completely satisfactory solution to them all. We may indeed need to be content with eliminating major causes of inefficiency and securing a modicum of co-operation in the pursuit of knowledge where it is most required. If, however, scientific and professional workers, whether within the walls of a university or without, are zealous enough in cherishing a high ideal of the functions of a university and give their minds, even in war-time, to such problems as these, then at least we may be sure that the universities of Great Britain will carry undimmed through these dark days their power to inspire, and to provide the loyal and unselfish leaders the nation needs both now and in the days of reconstruction to come.

CANCER: THE ROLE OF SURGERY, RADIUM AND X-RAYS IN ITS TREATMENT

THE treatment of cancer has occupied an increasingly important position in public thought during the last few years. The debate in Parliament on the Cancer Bill laid bare the scanty provisions for adequate treatment existing in many parts of Britain. The war crisis in September which temporarily curtailed medical facilities resulted in an insistent demand for the treatment of cancer, a demand not immediately heard for the treatment of most other diseases. One aspect of this interest is the difference of opinion as to the proper scope of radium treatment relative to other methods, a difference illustrated by recent and present correspondence in NATURE (**144**, 973; 1939; **145**, 151; 1940; also p. 347 of this issue).

Before attempting an assessment of the present status of cancer treatment, it will be instructive to examine first the extent to which cancer is in fact being treated in Great Britain at the present time, and the means available. A recent Ministry of Health inquiry* showed that in a representative sample 27 per cent of all cases were actually treated by either surgery or radiation, including purely palliative treatment. Allowing for possible groups of cases not coming into the sample, it is safe to say that less than 30 per cent of all cases occurring receive treatment. As to the means available, there are only two by which successful cure of cancer can be achieved—surgical excision and radium or X-ray therapy.

* "Cancer: An Enquiry into the Extent to which Patients receive Treatment." Reports on Public Health and Medical Subjects, No. 89 (H.M. Stationery Office.)

Surgery was first in the field, and indeed was for many years the only available method of treatment. The principle underlying its use is simplicity itself; extensive removal of the growth along with the whole of the affected part. The effective use of surgery in cancer dates back to about half a century ago. At that time surgical techniques were evolved which are still known by the names of their creators—Halstead, Kocher, Wertheim, and many more The surgery of cancer is now relatively stable, its accomplishments are known, its limitations accepted.

In contrast to surgery, radium and X-ray therapy are still young and developing branches of medical science. Although radium was discovered in 1898 and was applied to minor medical use shortly afterwards, it did not become an important means of treating cancer until after the War of 1914–18 In the decade 1920–1930 the significance of the work which was being done in three now famous radiation therapy centres—the Fondation Curie in Paris, the Radiumhemmet in Stockholm, and the Memorial Hospital in New York—was gradually realized. It was not, however, until about the end of that decade that the impact of these revolutionary methods became generally felt In Great Britain one result was the establishment of the Radium Trust and the creation of the National Radium Commission Centres for the provision of efficient radium treatment It is then no overstatement to say that this new medical specialty is a mere ten years old, and still in an evolutionary phase. This fact has three consequences In the first place, it is only over a very limited field of use that methods of treatment are as yet sufficiently standardized to represent an established practice of modern medicine. In the second place, it is vital that its value be judged in terms of its capacity as known to-day, and not in terms of its accomplishments of even a brief five years ago. Thirdly, it holds considerable promise for the future.

To arrive at an objective analysis of the relative value of surgery and radiation it is worth while first to examine the nature of the 27 per cent of treated cases mentioned above The striking fact which emerges from such a study is that treatment is limited to a comparatively small number of cancer types. Of the 27 per cent of all cases occurring which in fact received treatment, no less than three-quarters belonged to one or other of the following five cancer groups. cancers of the stomach, intestine and rectum; cancer of the breast; cancer of the skin, including genitalia: cancers of the mouth, tongue and lip; cancers of the uterus and vagina.

Cancer of the stomach, intestine and rectum constitutes almost exactly 400 out of every 1,000 cancer deaths and represents one of the very commonest types of cancer found. In view of this, it is depressing to find that only 8 per cent of this group are seen sufficiently early to permit an attempt at cure. The treatment is almost exclusively surgical and radiation is as yet of little value. A generous estimate of the percentage cured would be 15 per cent of cases treated.

Cancer of the breast constitutes 200 cases per 1,000 of all cancer deaths occurring in women It was found to have been treated in 68 per cent of cases. Breast cancer undoubtedly represents the field in which surgery has accomplished its greatest victories It is still the treatment of choice except in those cases which are inoperable when first seen In these, radiation does provide a useful alternative method In many cases both surgery and X-ray therapy are combined with great advantage. A fair estimate of the surgical cure-rate is 25–30 per cent of all cases operated on. In the really early cases a cure rate of up to 75 per cent can be obtained. Cancer of the breast should be looked upon, therefore, as a mainly surgical field.

Carcinoma of the skin represents only a small proportion of all the cases occurring. It can be treated by wide surgical excision, or it can be treated by radiation—either radium or X-rays—with equal or even greater certainty of cure and without the same degree of disfigurement, indeed, often such a return to normal occurs that the site from which the disease was eradicated cannot be distinguished. An estimate of the cure-rate of true skin cancer (squamous cell carcinoma), adequately treated by either method, may be given as about 75 per cent. The less serious form of skin cancer, known as rodent ulcer, if treated properly rarely proves fatal. This field is therefore one which can be equally called surgical or radiological, but the cosmetic advantage lies with radiotherapy.

Cancer of the mouth constitutes just under 100 cases per 1,000 of all cases occurring in men, and analysis showed that 71 per cent were treated. There is little doubt now that radiation, particularly radium, has become the treatment of choice in this disease. The majority of mouth cancers occur in parts where surgery is not practicable. Where excision is possible, for example, in some carcinomas of the tongue, surgical cure is

infrequent and is attended with marked disability. Extension of the disease from the mouth to the glands in the neck may, however, be dealt with either surgically or radiologically. Many cases of mouth cancer come for treatment when the disease is already advanced, yet even so cure-rates of 25–30 per cent for all the cases treated have been reported by British radiation therapy centres For the early case, the chance of cure is at least 50 per cent The mainstay of treatment of mouth cancer must therefore be accepted as being radium therapy.

Cancer of the uterus (uterine cervix) represents 133 cases per 1,000 deaths from cancer in women Before the days of radiation it was treated surgically. This has now been abandoned in all modern schools The present situation has been described in a recent survey where it is stated that "radiation offers a prognosis some 10 per cent better plus an appreciable salvage of inoperable cases . To-day the prognosis from good radiation therapy is a one in two chance of cure in an operable case, and a one in seven chance in an inoperable case, and in selected centres the prognosis is even better, the chances being two in three and one in four respectively". The rapid transition from surgical to radiation treatment is largely due to the statistical findings of the Health Section of the League of Nations. This disease can therefore be listed as an exclusively radiation field.

These five diseases together account for 75 per cent of the treated cases. The remainder include cancers of the lung, œsophagus, bladder, ovary, larynx and a large variety of less common lesions Talking in general terms, treatment by surgery and by radiation is probably about equally common, and radiation is showing curative possibilities in a number of lesions which are impossible of surgical approach.

We see, therefore, that in three out of the five main curable types of cancer considered, radiation now occupies a place so generally accepted that patients treated otherwise cannot be considered as receiving the maximum chance of cure.

The value of radium and X-ray therapy is, however, not limited to the treatment of forms of cancer in which permanent cure is possible. It can serve two other quite important functions. In a wide group of malignant growths, which include the lympho-sarcomata, radiation can control the disease and maintain the patient in a fair state of health for long periods. Another way in which radiation is extensively used is to obtain palliation of advanced cancers where cure is impossible. These cancers include the late stages of all those types which are curable in the early stages by radiation or surgery and many more. The growth of the tumour can be arrested temporarily, with disappearance of the attendant pain and disability Even although life is only prolonged for a short time the reduction in suffering is great Surgery has contributed two useful measures to the palliation of cancer—gastrostomy and colostomy. Both these measures, by affording mechanical relief in incurable cases, prolong life and reduce suffering

Much has been written on the dangers of radiation treatment, as in the past of the dangers of surgical treatment Where the disease concerned is cancer, in which the mortality of untreated cases is 100 per cent, danger should obviously not be overstressed In surgical techniques a certain 'operative mortality' is regarded as inevitable In the use of radiation for the cure of cancer similar 'treatment risk' must be faced. In both surgery and radiotherapy this risk varies in direct ratio to the magnitude of the undertaking and in inverse ratio to the skill of the operator or therapist. While the immediate risk of death is lower with radiation treatment, a new risk has to be taken, namely, that of local necrosis due to the treatment. At times this is unavoidable, and necroses may be faced at the time of treatment as being the price of what is regarded as curative treatment Such necroses can be repaired later by plastic surgery.

The nature of the action of radiation on malignant tissue is a totally different process from that of excision, and radiation should not be thought of as a refined form of cautery While surgery seeks the eradication of the disease by wide excision, radiation has a selective action on malignant cells in those groups of cases where the radiotherapist claims success. In the epitheliomata and the sensitive sarcomata it is possible to give a dose of radiation which will destroy the malignant cells while doing only temporary harm to the surrounding normal tissues. The margin between lethal dosage to the malignant cell and the lethal dose of the normal tissue is, however, quite a narrow one. To permit the successful use of this differential sensitivity an expert training in radiotherapy is necessary, both to assess a suitable dosage and to choose the best means of delivering that dosage accurately to the tumour with a minimal radiation of healthy tissue.

Radiation has occasionally been stated to

produce metastases and to 'stimulate' the growth of malignant cells. Neither of these statements can be substantiated.

In the development of radiotherapy a vast amount of experimental work is still necessary. At present the techniques employed are based on clinical experience, which is necessarily conservative. The choice, for example, of radium versus X-rays depends on the mechanical applicability of either to any particular lesion rather than on any known advantage of wave-length. In accessible sites it is usual to choose radium, which remains the more valuable of the two methods X-rays are used in the radiation of deep-seated lesions and in widening the zone of tissue treated from a radium source.

Another factor which requires investigation is the optimum overall time of radiation. At present the times used depend on clinical experience, and it is felt that other overall times or time splittings of dosage may be found in the experimental field which will alter considerably our methods of treatment

While stressing the need for developmental work in radiation methods and the value of surgery and radiation in their respective fields, it is necessary to state that the greatest increase in the cure-rate in these fields would be obtained by a successful campaign to get patients in the early stage of their disease. A well-planned scheme of public education and clinics as envisaged in the Cancer Bill would facilitate this.

RUTHERFORD

Rutherford

Being the Life and Letters of the Rt Hon. Lord Rutherford, O M By Dr. A. S. Eve. Pp. xvi+451+18 plates. (Cambridge: At the University Press, 1939) 21s net.

PROF EVE'S account of the life of his old friend Lord Rutherford treats it in the perfectly straightforward manner which such a book should. He takes the reader steadily through the life from boyhood in New Zealand to the 1851 Exhibition at Cambridge, the chair at Montreal, the chair at Manchester, and the return to Cambridge. A great part of the history is given through the medium of Rutherford's letters, many of the earlier ones being those written to his future wife.

The order of presentation is rather strictly chronological, so that successive paragraphs may deal with entirely different subjects; for example, they may consist in accounts of a public lecture, a holiday journey, the organization of a department, and a new scientific discovery. In describing the purely scientific work, Prof. Eve at intervals devotes a few pages to a non-technical explanation of its import, which should help the inexpert reader in understanding the steady progress of the discoveries in which Rutherford took the leading part. In fact the biography is cast mainly in the form of a chronicle, and this is exactly the form it should have. There will remain for some later historian, who will have gained the perspective and impartiality of time, the task of assessing the respective merits of the enormous contributions that Rutherford made to physics. Taken in conjunction with his published books and papers, the present biography will provide very complete documentation for such a historian, and it should go a long way towards protecting Rutherford from the two dangers to which the lives of the great seem to be specially exposed, on one side the degeneration into a dreary hagiography, and on the other the psychological account of the (usually Freudian) thoughts which the biographer thinks that his subject ought to have been thinking.

With a biography, as with a portrait, the author is always faced with an almost insuperable difficulty, that of satisfying both those who knew the subject and those who did not. The first expect to be reminded at every turn of the living original, whereas the others, with no personal memories, have to build the whole image out of the author's own work. So it is natural to ask whether Prof. Eve has 'got it across'. He has certainly given himself the best chance of doing so by his copious quotations from the letters. These, be it said, are mostly quite ordinary letters, dealing with the happenings of Rutherford's life, such as those written to his family when on a visit to America, or those to friends on the Continent renewing relations after the War of 1914–18. They are good straightforward descriptions of events, not embellished into anything like belles-lettres—had they been so one would have doubted their authorship—and anyone can feel that he could almost have written them himself. But not quite, for there is a tremendous common sense about them and a vigour raised to high power, which is the characteristic that his intimates will most

remember. But in reading them the intimates will have in mind the associated memories of the general raciness of his conversation, of his amusing reminiscences and the critical but usually kindly comments on his contemporaries. This side of him is very much harder to describe in a biography, because it can only be done by illustrations of a topical kind, and the mere attempt to give them would destroy the lightness which is their essence. It is a matter for briefer treatment than is possible in a book, and we may hope that, before memories fade, there will be gathered together a Rutherford saga, of the kind of which a beginning was made by Tizard's lecture last spring. There are many men, great to their friends but little known to the world, of whom the same sort of thing is true, and usually their memory does not long survive. But here the greatness was combined with an external greatness patent to the world at large May we not hope that this will just make the difference and lead to the survival of the whole man.

It is impossible to read the life without trying to estimate what the verdict of the distant future will be of Rutherford's various discoveries. Many of them, which in another man would be counted as of the very first class, can be attributed to accurate timing on his part. Rutherford himself used to say, in connexion with some of the wilder speculations of his contemporaries, that no one could see more than an eighth of an inch beyond his nose, and that only a great man could do even that. He had himself just that extra little range of sight beyond the eighth that got him there ahead of the rest One cannot doubt, for example, that the law of radioactive decay would have been explained by someone else, if Rutherford had not done it a few months earlier In other cases he got the lead by his capacity for choosing the right one among several confusing alternatives, by his gift for always "picking the right bottle off the shelf". Thus one distinguished man of science would write to him reporting a new type of radiation, and he would be entirely unmoved, correctly attributing the result to some unconsidered impurity, while another would write a very similar letter and he would stop all the other work of the laboratory and Chadwick would discover the neutron.

In the case of some of his discoveries, however, Rutherford was much more than a few months ahead of his competitors. For example, the study of α-particle scattering was undertaken in order to probe into the atom, and the ordinary scattering by electrons did serve to give at least a strong suggestion that the number of electrons was about half the atomic weight; the scattering of a few particles through broad angles was an unforeseen extra gift. It is one of those profitless but interesting speculations to conjecture what would have happened if Geiger had failed to detect those particles, or if, as it would have been almost natural to do, he had explained them away. The nucleus would have had to wait; but for how long ? Atomic number would have been discovered, but it would have been through Moseley's spectra and it would have been only a curious numerical rule unsupported by any theory. Would Bohr have made his theory of the hydrogen spectrum, without the guiding principle that there was a centre of force attracting according to the inverse square ? Probably, but it might have been somewhat later, and the theory, suspect to the orthodox even as it was, would have had a much more difficult passage After that there would still have been the experiments on collision to repeat, and so it seems likely that Rutherford found the nucleus at least three or four years before anyone else would have done it.

In the discovery of atomic disintegration he was probably even farther ahead of his contemporaries, and he owed this largely to his breadth in insisting on developing technical methods and exploring whole fields, where smaller men are content to solve single problems one at a time. This wisdom went much farther still, for at an age when most men are entirely set in their habits, he showed that he could recognize that his old simple methods were becoming inadequate for the new knowledge, and that he must—and that he could—embark on the elaborate engineering feats of the modern physical laboratory.

The discoveries of the present epoch can be divided into two types, for which a very good discrimination is according to whether Rutherford liked them or not; the difference can be felt, but it is hard to put it into words in any other way The nucleus and disintegration were his own, and he foretold the neutron and was in at its birth. He liked Bohr's theory of atomic structure, and accepted the new quantum theory though without much enthusiasm; perhaps this was because for a time it put the theorists above the experimenters. At any rate, he could welcome Gamow's theory of radioactive change, and Mott's work on the interference of α-particles with helium atoms. But the positron was not to his taste; of course he accepted it, but the very abstract idea of 'holes' did not fit his habit of thought. Would he have liked the meson ? Probably not. But the most recent discovery of all, the fission of uranium into comparable parts, that would surely have been a discovery which, had he been spared for little more than a year longer, would have been one of the most acceptable to his genius.

C. G. DARWIN.

ELECTRIC CLOCKS

Electrical Timekeeping

By F. Hope-Jones. Pp xx + 275 + 6 plates (London: N. A. G Press, Ltd, 1940.) 10s net

SOME few years ago, Mr Hope-Jones brought out his well-known book "Electric Clocks", and I had the privilege which I much enjoyed of writing a notice of it, which appeared in NATURE of October 17, 1931. I am very glad to be enabled again to notice a new book—"Electric Timekeeping"—by the same author I say a new book because the title is a little different. I think it should be called a new and enlarged edition. "Electric Clocks" came out when it had become generally recognized that the Shortt clock had revolutionized our ideas as to the possible attainable accuracy of pendulum clocks, and when for the first time the uncertainty had been brought down to a matter of a second in a year. There was then full justification for the author, who had himself invented many of the features on which success depended, adopting the role of the high priest and laying down the law as to what is good and what is bad As anyone who has seen the first would expect, the present work does not falter in this respect.

The author, who has devoted himself to the subject of accurate clock construction for nearly half a century, is so saturated with the subject, and is so familiar with the almost innumerable ways in which the electric current has been harnessed as an aid, that his presentation of the history of the development is almost bewildering in its thoroughness, but there is this which makes his treatment of real value It is not a mere catalogue of a thousand-and-one devices in chronological order, but a very critical discussion of each showing the valuable original steps which, however, lacked something necessary for real success, or the essential faults in principle which were so common.

In the earlier volume the author led up to what might well be called the perfect clock—or very nearly perfect clock—the Shortt clock In the present volume the history is mainly a repetition, but much has happened since "Electric Clocks" appeared The quartz crystal clock, though it had proved its value so long ago as the year 1928, had not then become so well known as it is now, or perhaps had not reached the present high level of performance, which is, I believe, an uncertainty in the rate of one second in two or three years. In 1928, comparisons of Mr. Marrison's quartz clock in New York connected by land line with Mr. Loomis's three Shortt clocks at Tuxedo demonstrated the disturbance of gravity by the moon Then again the time laid on by the alternating current network in the country, though known as a possible source of accurate time, had not become general as it now is; and in this, by the way, the author appears to have been the first to point out the possibility*. Again, time at sea, which used to be altered daily by the captain when he said "make it so", is now beginning to pass at a variable rate made to fit the easting or westing of a ship on a plan also proposed by the author These, the Post Office "Tim", and many other things are discussed in the additional matter.

The author may well be pleased to have had the support of the late and of the present Astronomer Royal. These two great authorities have written the forewords to the two volumes, and this is a distinction of which he may well be proud. He is also able to exhibit a frontispiece which itself is an attraction. When crossing the Atlantic to attend a meeting of the Franklin Institute, where he was presented with the much-prized Gold Medal for his share in the development of the Shortt clock, by rare good fortune Einstein was on board. The frontispiece is a 'snap' of the two in earnest conversation autographed by Einstein himself

It is now nearly fifty years since the author developed that admirable production the synchronome clock, which was a well-deserved success. Relying on the principles which he never tires of preaching, he invented element by element that invaluable instrument. I must mention in particular two of these. The first is the step-by-step dial ratchet which never fails. This is figured on p 103 It may seem a small thing, but it represents a degree of perfection unknown before. It has the great merit of not being upset even if the ratchet wheel is eccentric or badly divided. The other is the synchronome switch which applies a gravity impulse to the pendulum every thirty seconds. This contains an element of the first importance, a contact which is a really forcible one, that itself transmits the power to lift the gravity arm and thereby lasts only so long as is necessary. This saves battery waste, provides a sharp time signal, and it never fails.

The triumph of the Shortt clock, which after all is based on the synchronome clock, has not caused the author to rest on his laurels. The latter part of the book records one after another of his further inventions. One is a method of synchronizing a light half-second's pendulum depending solely on

* "Lightning", November 15, 1895.

circular error. This is a beautiful device, and if the synchronizing current is first set for every second it very soon starts from rest and is in proper phase.

Another and much less expected invention, if indeed any invention by the author relating to clocks can be considered unexpected, is an alternate current motor of great ingenuity and value. Two microscopic motors of a few mouse-power had hitherto almost monopolized the field One was the high-speed self-starter, the Warren motor, which can only go one way, and the other the toothed disk lower speed motor, which is not self-starting and which will go either way Some few weeks ago a public clock was seen to be going backwards and this led to a crowd wondering, I suppose, how long it would be before it would become yesterday again This might have been due to the man who started it turning the twiddle nob the wrong way. But the author again comes in with an extra slow-speed toothed wheel motor turning once a second with a permanent magnet for the stator. This, he says, is more efficient than the others, which it may well be. I have used the others in other apparatus and determined the mouse-power of each, which was surprisingly large. I should much like to have one of these new motors on which to experiment.

These are only a few of the author's later achievements. They are all so neat and so practical that it is with regret that I am compelled by consideration of space alone to leave them unmentioned.

The book is so well written that in spite of the host of alternative devices described, anyone with a taste for nice mechanics will read it through with avidity and then read parts of it again

C. V. BOYS.

PAPER

Paper and its Uses
A Treatise for Printers, Stationers and Others. By Edward A. Dawe Vol. 1. Fourth edition revised. Pp xiv+188+28 plates. Vol 2 Samples of Papers and Boards. Pp. vii+157 samples. (London: The Technical Press, Ltd., 1939) 2 vols., 15s. net

TWO factors combine to make the task of reviewing these volumes an easy one. In the first place they represent the fourth edition of a work which may now fitly be regarded as a classic of the paper and allied industries; secondly, until recently the author directed the activities of the laboratories of H.M Stationery Office. Both of these considerations are in evidence in the contents of the book. The treatment of the subject combines, in fact, that authority which is born of many years of experience, and that absence of errors and minor defects which is so seldom attained before a work has passed through its early editions.

As the author states in his preface to this edition, the fundamental processes of papermaking have not altered in the relatively short period covered by the earlier editions of the book. Nevertheless, a combination of scientific skill and improved craftsmanship has resulted in many advances, both as regards the quality of the product and the rate of output. Such developments are the principal new features of this edition, the up-to-date nature of which is indicated by the fact that it includes subjects such as the purification of pulp by centrifugal methods, the manufacture of 'two-wire' and artificially conditioned papers (which have contributed so prominently to the solution of the problems of high-speed printing); the coating of papers on high-speed paper machines; air-mail papers; and standards of permanence and the factors which affect this important property of paper.

The first section of vol. 1 is a brief but clear description of paper manufacture, and it follows the usual lines It is, however, the two subsequent sections, which deal with the different kinds of paper and paper-products and their uses, which single out this work from the many others on papermaking. Into the space of some sixty small pages is compressed a wealth of detail based on sound practical experience. Nothing of importance seems to have been overlooked, and few of the multitude of varied products which originate as paper are omitted. The final sections deal chiefly with testing methods and standardization (matters with which the author has been specially associated), paper trade customs, and methods for the interconversion of sizes and weights of papers. Here again the author steers his way deftly through the maze of intricacies and traditional nomenclature with which the paper industry is still encumbered, and which his own efforts towards standardization have done so much to help to remove.

In the second volume are bound up 157 samples of typical papers and boards, together with the appropriate descriptive details. This volume is

dated 1929, and it seems rather a pity that the opportunity was not taken to bring it up to date also. In some instances (notably the sensitized cheque paper, foil papers and offset papers) the samples included would not find favour among users as typical of the best of their kind This comment, however, applies only to a relatively small proportion of the samples, and the value of the volume as a whole (especially to the student, for whom it is primarily intended) cannot be over-estimated.

Since the author has now retired from his official position, this work may be regarded as a parting gift to the industry. It certainly deserves to command an appreciative welcome from an industry already so much in his debt for the years of unstinted and able service he has devoted to it

JULIUS GRANT.

ECONOMY OF A PRIMITIVE PEOPLE

Primitive Polynesian Economy
By Raymond Firth. Pp. xii+387+8 plates. (London: George Routledge and Sons, Ltd., 1939.) 15s. net.

THE material upon which Prof. Firth has based his study of primitive Polynesian economy in this book was gathered in the course of his expedition in 1929 to Tikopia, one of the islands of the British Solomons group in the Pacific. A valuable study of the social anthropology of the inhabitants of the island already stands to his credit in a substantial volume. He now turns to an investigation from another point of view—a point of view which is claimed, and justly claimed, to be new, namely, that of the system of values which determines preferences in the satisfaction of needs.

The people of Tikopia, it will be remembered by those who are acquainted with Prof Firth's earlier book, are virtually untouched by White civilization; and in their mode of life they may be regarded as an example of a people of simple backward culture. When, however, this culture is submitted to examination, it is seen that what may be termed their economy, as thus defined, is by no means simple, but on the contrary is of a highly complex character. It is made no easier of understanding in the eyes of a Western observer by the absence of price and its common measure, money. This absence is, of course, a fact which has not passed unobserved by previous observers of life in other primitive or backward communities; and the differences in standards of value and media of exchange have been the subject of instructive study. Prof. Firth, however, is the first to examine the problem to which it gives rise from the point of view of the functional anthropologist, prefacing his study with a consideration of the general question.

Now it must be clear that the study of the economy of a primitive people may be approached from two very different points of view On one hand the sociologist, and the observer whose record is intended to meet the needs of a Western audience, will make use of a classificatory system and a terminology based upon concepts which in theory, at least, are abstract and of universal application. The anthropologist, on the other hand, in so far as he aims at an accurate and objective ethnographical record, is concerned with a standard of values that is relative—relative to the culture of the people under investigation. It will be remembered that Prof. Malinowski records a striking example in his account of the system of ritual exchange in the Trobriands in his "Argonats of the Western Pacific", while further examples to which reference has been made are afforded by the refusal of the peoples of Africa to commercialize their cattle, or their reluctance to abandon the use of the hoe for more efficient means of cultivation. It is, however, neglect of this principle of the relativity of any given system of values which has vitiated or caused the neglect of the study of primitive economy.

Applying this principle to the people of Tikopia, Prof. Firth shows how in the instance of food, for example, the bare biological need is transcended by values of a non-nutritional order, as a means of meeting social obligations, the responsibilities of kinship, and other ritual requirements; or again in fishing, it is not the remunerative value of the catch which will determine the direction of effort, but ritual which demands that the first catch should be a shark, rather than the less difficult and more profitable flying-fish. Thus the general trend of this investigation may be summarized as showing that the system of values which it might be argued applies to 'economic man' becomes a matter of social relations, and must be considered in the light of that fact, requiring in the study of primitive economics a profound modification in the usual line of approach.

Prof. Firth has produced a most valuable and stimulating study, which will repay careful consideration, not only by the anthropologist, but also by the administrator and others who have to come into intimate touch with any people of backward culture.

CAN CHRISTIANITY SURVIVE ?

The Gospel and the Church
A Study of Distortion and its Remedy By the Rev Canon Charles E Raven. Pp. 256. (London: Hodder and Stoughton, Ltd., 1939.) 8*s* 6*d* net

CANON RAVEN examines the character of Christianity in Apostolic days and also in the early centuries, and shows the serious nature of the distortions that occurred These are more obvious in the formative period between the second century and the collapse of the Western Empire There were three directions especially in which the primitive Gospel was abandoned: The renunciation of Nature, the distortion of history and the development of institutionalism Dealing with the first of these he points to the stress laid on miracles, the craze for which had permeated all classes of society, and as a consequence of this obsession religion was identified with the crudest supernaturalism The pernicious influence of Jerome in dealing with sex is well known and is shown by his deliberate mistranslation of "almâh" as meaning "virgin" instead of "a young woman of marriageable age", and in many other ways as well. He maintained that both Joseph and Mary preserved their virginity and explained the "brethren" of Jesus by asserting that they were His cousins, children of Clopas or Alphæus and another Mary, sister to the mother of Jesus.

In history the distortion is seen in the almost complete neglect of the Gospel records. With the disappearance of the earthly life of Jesus there arose a multitude of saints, some purely mythical, and through neglect of history religion was largely divorced from life The loss of the sense of the value of Nature and history implied a change in the quality of Christianity, so much so that during the fourth century "it is doubtful whether we ought to say that the Church conquered the world or that the world invaded and subdued the Church".

In order to explain the persistence of the Church's distortion in regard to Nature and history—and we cannot deny that this distortion is still evident—it is necessary to take into account another condition of its early period, the fixing and form of its organized structure. Owing to the rapid crystallizing of Christian institutions and to the form that they adopted, transitory stages of belief became part of the Church tradition. This subject is dealt with by Canon Raven with consummate skill in Chapter v, "The Church Organic and Organized", and he has no hesitation in attributing the lowering of the spiritual standards in the Christian institutions of the third century to the assimilation of Mithraism. The degradation of the Eucharist is described as one of the most tragic of all the distortions of the Apostolic gospel, but many will wonder whether the description given of the superstitions associated with the Eucharist in the third century is not applicable, in part at least, to large sections of Christendom to-day. If Christian orthodoxy refuses to accept the value of Nature and history—a value inherent in its own basic tenets—can it continue to survive in the environment of modern knowledge ?

Two chapters, "The Recovery of Nature" and "The Necessity of History" are constructive, but readers will ask how far it is possible to apply in practice all that is advocated. We are told that if we are to learn the lessons that Nature can teach, "it must be by recovering the sense of its wholeness and its value, the humility and the wonder which science in its conflict with religion too largely lost". Furthermore, it appears that the population outside the churches which has discovered the absorbing interest of Nature can be approached by the churches if they free themselves from a distorted tradition We are disposed to think that Canon Raven has over-estimated the number of people with the "absorbing interest in Nature". In addition, the form of Christianity that would result from his suggestions would be too emaciated for the great majority of people (we are, of course, considering the adherents of Christian tenets outside Anglicans and Protestant Nonconformists), and many would find refuge in magic, charm, talismans, etc, rather than in a religion largely devoid of the element of mystery. It is certain that Mediterranean Christianity would never assimilate a religion similar to that of the Apostolic days. Again, if we recover a sense of the importance of history, is it possible to believe, remembering the reaction against liberalism from which so much was expected, that a synthetic theology will ensue out of the antithesis of recent years and restore to us the proportion of the faith ? Throughout his constructive scheme Canon Raven, in the opinion of the present reviewer, appears to have largely overlooked the strong appeal still made by the pagan elements surviving in Christianity.

The book can be recommended because it contains so much with which all reasonable Christians can agree. M. DAVIDSON.

WAR AND RECONSTRUCTION*

By DR. JULIAN S. HUXLEY, F.R.S.

EVERYONE realizes, though with very different degrees of awareness and to the accompaniment of feelings that range from ardent hope to sullen resistance, that this War is bound to be followed by radical changes in the structure of separate societies and the organization of the world. In this connexion, biological analogy is helpful not only in creating a general background against which to envisage the coming change, but sometimes in suggesting detailed points in the new order

In the first place, biology reminds us that change is the normal (though not the universal) rule of life, that certain aspects of biological change can legitimately be called progress, and that man is biologically speaking a very recent type, whose social organization is still primitive in the extreme when looked at in the light of evolution The lesson of biology for the resistant conservative is therefore that his resistance to change in general is not only useless but also immoral

But biology has also a warning for the over-enthusiastic progressive Biological change has normally (though probably not universally) been a very gradual process The rate varies considerably as between different lines of descent, and at different periods of the world's history, but the change is normally effected through step-by-step alterations of existing organization In general, it is as frequent for old organs to be converted to new uses as for wholly new organs to be evolved The zeal of the revolutionary for getting rid of the old system root and branch is thus likely to be wastefully destructive and in the long run to delay progress

From the point of view of human biology, what are the chief features of the present time which have altered man's social environment so much that corresponding alterations of social organization are needed to meet them—and which, incidentally, have helped to bring about the War?

The first is the increase in the efficiency and speed of transport and communications, accompanied by the virtual abolishing of frontier space for expansion. This is forcing the remotest regions of the world into often unwilling interaction It on the one hand provides a potential basis on which world unity could be built, and on the other makes the lack of that unity more and more disadvantageous

* Substance of the British and American Association Lecture delivered before the American Association for the Advancement of Science at Columbus, Ohio, on December 30

The second is the increase in the potential of power available to States This is most dramatically seen in respect of war Armaments have become many times more efficient during the last twenty years. The result is that war has grown out of scale with its function During many centuries it operated, wastefully enough, yet with a certain efficiency, in adjusting the variations in the balance of power caused by geographical discovery, economic change and population pressure But to-day, both its destructiveness and its expensiveness have got out of hand, and have become wholly incommensurate with any positive results which its agency may help to accrue This, however, is not the only way in which State power has shot up The dictator regimes have taken into their own hands the organization of economic power and also of the power of opinion They are in literal truth totalitarian

The biological analogy shows that for competing nation-States merely to respond to this challenge by corresponding permanent changes in their own organization (however necessary such changes may be as a temporary measure) would be to court disaster Size and armament alone lead up a cul-de-sac The giant reptiles of the Mesozoic included the largest carnivores the world has ever seen, like the Tyrannosaurs, and the most heavily armoured animals, like the Stegosaurs and the Ceratopsians. They answered bulk with bulk, aggressive with defensive warfare But they were all doomed to extinction as soon as the changing environment gave the insignificant but brainier little mammals their chance The contraction of the world due to better communications provides the corresponding change of environment to-day, brain-power spent on devising new systems is inevitably destined to supplant the present armoured monsters of the nation-State era The only question is whether it shall be now, or after more waste and destruction.

A third fact of the utmost importance in the modern world is the search for a new mystic, a new super-personal driving force. Traditional religion of the supernatural type has lost both ground and grip: the curious materialist-idealist compound which expressed itself in the nineteenth century's belief in the inevitability of progress, in the power of knowledge to mould human nature and produce almost millennial prosperity and peace, has wilted in disillusion. In their place, three great nations have already erected new

pseudo-religions, all of them involving the glorification of the State. The most radical is that of Nazi Germany, which uses the race-concept as its mystical basis, while for Italy the mystic is the nation, and for Russia the millennial picture of the truly Communist society, when Government will wither away.

In all these cases, however, the mystical driving concept is linked with the national organization of power: and this inevitability has brought a recrudescence of intolerance, persecution, and cruelty which has contributed largely to the final shattering of the belief in progress in other nations. History teaches us, however, that intolerant persecution always arises when an unintelligent mystic doctrine is held with such intensity that the end is deemed to justify the means, and that the persecution will be violent and brutal when the mystic doctrine is bound up with the system of power.

Two by-products of this situation are to be noted. First, the unprecedented refugee problem which it has created—unprecedented partly because of the violence and extent of the persecution, partly because of the nationalist unwillingness of other States to absorb new alien elements; secondly, the *distortion of truth which it has* brought about, with resultant lowering of the quality of scientific research in the countries concerned. A biological analogy here would seem to be the incredibly small size of the brains of the giant Mesozoic reptiles.

The fourth great feature of the present is the trend away from *laissez-faire* and individualism towards planned organization and collective action. During the period of rapid industrial expansion in the nineteenth century, *laissez-faire* individualism worked well enough, in spite of all its attendant horrors of slums, exploited labour and imperialist expansion. Indeed, it is probable that no other system could have so rapidly mastered the forces and resources of the world. But to-day, like war, it is defeating its own ends and proving unsuitable for its functions. It is proving unsuitable for four reasons; first, because unplanned individualisms, as the world contracts, tend to cancel each other out; secondly, because its basic time-span is too short for many types of projects—the individual demands a return on his money within his own lifetime, or at least for his children. Thirdly, because the agent is too localized; the individual demands a return to himself or to his family, whereas many projects are desirable by making a return to the community in general, through better health, greater taxable capacity, higher standard of living and increased consumption demands, and so on. Fourthly, because it prompts the recurrent vicious cycle of trade boom and trade depression.

Already the world has moved far from simple *laissez-faire*, but the present system is a compromise, and the agencies of collectivized planning are as yet extremely imperfect.

The fifth point is the gradual evening out of world resources in raw material and power. This has been accomplished partly by new methods (for example, utilizable nitrogen from the air instead of from Chilean nitrate beds), partly by artificial substitutes (synthetic dyestuffs, artificial silk, plastics); partly by new transformations of old sources of material or power (motor spirit from coal, hydro-electric power), partly by substituting new raw materials for old (aluminium for heavy metals). The net result has been that, while many inequalities of distribution remain (U.S. helium, Canadian nickel, etc.), the bulk of natural resources is becoming much more uniformly spread over the habitable globe.

The sixth striking feature of our time is the great increase in leisure—some of it in the compulsory form of unemployment and retirement at comparatively low ages. (During actual war, much of this leisure is of course abolished.) The totalitarian countries have made some interesting attempts to provide social organizations for the better utilization and enjoyment of leisure, but so far in other countries the individualistic *laissez-faire* tradition, which tends to regard State-controlled organization as undesirable interference, has prevented any real evolution in this direction.

Seventhly, there is a new approach to colonial problems. Partly this is due to the jealousy of the 'have-nots', a normal phenomenon whipped up to exceptional intensity under the pressure of nationalistic feeling; but in large measure it is due to a new attitude, which has already found expression in the mandatory principle, and to a dawning realization of world unity and the part to be played therein by peoples whose social development has been retarded.

We have drawn one evolutionary analogy—that of the over-armed and under-brained reptiles of the late secondary era. We cannot, however, suppose that the subsequent course of biological evolution will serve as a pattern for the next phase in our own history. This would imply that the over-armed nation-States would disappear and their places be taken by smaller nations more concerned with flexibility and intelligence of social behaviour. This is ruled out by the shrinkage of the world. Do not let us forget that man differs from all other major biological types in consisting of but a single inter-fertile species, in possessing much greater control over the environment, and with the power of forming much larger communities. The only possible climax for such a type is that it should extend over the entire habitable globe in the form

of a single community, whatever the organization of that world community may be. All intermediate stages, of racial, tribal, national groups, are, in the long perspective of evolution, inevitably unstable.

But for the immediate future, both biological analogy and historical experience demand a step-by-step advance. Some functions are sufficiently advanced to be put on a world footing without dislocation, while for others the step can only be on to a regional basis The chief functions which could be stepped up to a world platform are those concerned with primary products and raw materials, with certain aspects of research and of communications, and with sea-power. The chief functions for which we must be content with the intermediate regional set-up are the political, in the broad sense of the word.

Let me amplify this second point first. National culture and tradition, usually combined with language, is the strongest political force in the world to-day. So-called race problems, when analysed, always turn out on analysis to owe their acuteness to differences in culture and economic level which happen to be associated with genetic differences. It is wholly premature to envisage any immediate world-government which could stand up to the tensions introduced by existing differences in national culture Regionally, however, there is a hope.

The U S S R. has already established a federal system over one-sixth of the world's land area Pan-America is beginning to emerge The present struggle between Japan and China could without too great difficulty be forgotten in a Far Eastern federation. Malaya and tropical Africa are destined by Nature to take their place as world regions as their inhabitants progress toward economic efficiency and political self-government. Finally there remains Europe, in the cultural sense of the area where Western civilization arose and where it still flourishes, however impeded by the barriers of nationalism and the counter-currents of totalitarian philosophy--regionally the geographic Europe minus European Russia but plus the Asiatic and African fringes of the Mediterranean Sea.

The most urgent political post-War task is the settlement of Europe. It is here that the greatest number of powerful nationalisms occur, here that they are most crowded, here that the ownership of tropical territories is chiefly concentrated. Geography and history dictate a regional solution for this area, now torn by war. And the War is a civil war, between different representatives of the European tradition—the tradition based on Greece, on the Roman Empire, on Christianity, on representative government, on the spirit of modern science and industry.

Yet the differences between the various nations or groups of nations within Europe are so great, their separate traditions within the enfeebled European tradition so strong, that it would be hopeless to attempt at one bound a full-fledged federal system like that of the United States. On the other hand, a League system, even if confined to Europe, will not be enough; the experiences of the League of the American States prior to their federation reinforces the lesson of the last twenty years. A League system will not work because it is a contradiction in terms: the absolute sovereignty of its member States is irreconcilable with collective action for the benefit of the whole Some abrogation of sovereignty—in other words some step towards federation—is essential.

What is the minimum degree of federation which would be effective? An executive organ, an advisory organ, an organ of discussion, a training organ, an organ of opinion, a budget, and, in the present state of the world, alas, an armed force The executive organ would be restricted to a council, in which smaller countries could be represented groupwise The organ of discussion would be some sort of assembly, not necessarily elected by Western democratic methods, but representing functions as well as regions. For training there is needed some form of international staff college; for moulding opinion back toward unity and away from nationalist separation, a broadcasting service and perhaps a film unit and newspapers and periodicals The budget might be raised as a percentage levy or in various other ways: the one essential is that it should be adequate in amount —at least a hundred million pounds per annum. Inadequacy of finances was one of the reasons for the failure of the League. The extent of the inadequacy may be seen from the fact that the total of the contributions of member States during any of the last few years was just about as much as what the London County Council spent annually on main drainage alone! As for armaments, if the European council alone disposed of military planes, heavy tanks and heavy artillery (the manufacture of which cannot be kept secret), effective disarmament, both qualitative and quantitative, could be imposed on member nations, and yet Europe as a whole would dispose of a powerful force. The units of the force should presumably be stationed whenever possible in the territory of small nations; that would be an important contribution on their part to collective security.

The budget would be mainly employed, apart from armaments, on long-term development schemes which would not readily attract private capital—partly in Europe (and there mainly in the less-developed nations, though special projects

could be contemplated in any country), partly in the colonial dependencies. But a reasonable fraction would be reserved for the other European agencies and for leisure organizations on a European scale.

To these last I shall return. Meanwhile let us consider world organization. The most important of these would deal with primary products and raw materials, and their basic function would be first to iron out the vicious cycle of slumps and booms, and secondly to promote a higher standard of living through higher consumption. The League has been blamed, perhaps rightly, for its lack of proper organization on the economic side. It is, however, fair to remember that in 1919 the machinery for large-scale control of raw materials was virtually non-existent. Most of it was called into being by the great depression of 1929 and subsequent years. It exists in the form of cartels and other international schemes for commodity control. From the technical aspect of economic machinery, these have been much improved during the last decade: it remains to alter their direction, to harness them in the interests of consumption and of the general public instead of permitting the dominance of a policy of restriction and short-term profits for sectional interests. From the technical point of view, the provision of really adequate buffer pools and the wholehearted application of scientific research would also lead to improvement.

They would be under a Permanent Commodities Commission of the League of Nations or whatever world international organization took its place. In addition, such a body would have the duty of canalizing world long-term investments for development purposes, partly in the form of rural loans and the like, partly indirectly through the setting up of development commissions and of what might be called international chartered companies, to promote the general development of backward areas. Development commissions, somewhat on the pattern of the Tennessee Valley Authority, would be suitable for self-governing areas where co-operation can be effected with local government authorities; while the chartered company type of organization will be needed for dependent (non-self-governing) territories. Such bodies would (as with similar semi-public organizations like the London Passenger Transport Board) be compelled to return all profits above a fixed rate into the area for which they were responsible.

We may take colonies next. Here, as with Europe, the task is to steer a safe course between the Scylla of doing nothing and the Charybdis of attempting too much and seeing the shaky edifice collapse. It is easy enough to say, as many people are saying, that all colonies should be handed over in the immediate future to an international commission. But would it work? Those who know something about native peoples and the problems of tropical administration say no. There must be somewhere in the system a firm organ of authority and an adequate focus for the loyalty both of those administered and those who administer them. Until the incipient federation of Europe that we have outlined grows into a true federal government, and until training and tradition have produced an *esprit de corps* in the international administrative service, these essential organs of colonial administration will not exist internationally. To take a somewhat remote and yet valid biological analogy, before the adequate development of the cerebral cortex, lower vertebrates had to delegate most of their behaviour to a rather poorly co-ordinated system of reflexes and simple instincts.

The remedy would seem to be retention of the principle of national and executive authority at the periphery, with a reasonable and increasing degree of international non-executive control at the centre. The separate colonies and their administration would remain British, French, Belgian, and so on, though they should all be put on the footing of mandates, and the Mandates Commission strengthened by the grant of powers of investigation on the spot in addition to mere review of policy. Under the European council would be established a colonial commission, truly international, with small but picked international staff of research workers, experts and travelling advisers, and the power of allocating considerable grants out of the European common budget for education, for health, for conservation, for roads and other public works.

It would be desirable that a small but progressively increasing fraction of the technical and perhaps later of the administrative posts in the local service should be thrown open to nationals of other countries; but the appointments should be in local hands, not in those of the international authority.

A somewhat similar system works quite successfully between the Federal and State authorities in the Tennessee Valley Authority, and it ought to work well enough in the colonial sphere. The scheme would have to be modified in the minor colonial areas, such as the Caribbean and the Pacific, to allow of the participation of other powers, for example, the United States and some of the British dominions.

Do not let us forget that international administration is *per se* no solution of the basic colonial problem, which is the development of the colonial territories and their inhabitants towards self-

government. It could only help at the European end, in reducing jealousy among the great powers. But even the partially international scheme set forth above would remove most of the political objections to the transferring of colonial mandates to other powers

Meanwhile the world organization, too, through its international chartered companies, its world loans, and its expenditure on research, would be aiding in the progress of the tropical countries The international staff college would have its colonial section, and after perhaps a generation, there would have been built up a truly international *esprit de corps* among the staff

I mentioned the growth of leisure and the need for its better organization This is especially urgent in Europe, for it will be largely through such organization that the people of its separate countries will be able to understand the European tradition and to participate in it, only so to experience the greater European loyalty which will render the lesser national loyalties innocuous, a source of local but co-operative pride instead of a source of jealousy and hate

To do this, the democracies must learn from the totalitarian States, they must build up their own leisure organizations, and then extend the principle internationally One can think of so many ways in which such organizations could promote "life, liberty and the pursuit of happiness" on the international plane Properly organized travel in international parties, youth hostels, walkers' and climbers' hostels, all over Europe International festivals like Salzburg in the old days, or Oberammergau, but more numerous and made available to many more people, an international system of holiday camps, of summer schools, of study and hobby groups, of retreats, dotting Europe from end to end The whole could easily be linked up with the extension of the exchange system which will be necessary on the educational side—exchange of undergraduates, of graduates, of teachers and professors, to a certain degree of schoolboys, and also with international schemes of refresher courses for administrators and professional men of every description, and of adult education One may even envisage the substitution of citizen service for military conscription, and the placing of that, too, on a broad inter-European basis In all such ways, Europe could become a reality to its inhabitants, and the onward flow of its great cultural tradition would be reinforced

Let us try to envisage what improvements such changes would bring about Nationalism and self-determination would not disappear; but they could be relegated to the cultural sphere, as has been done within the U.S.S.R., and banished from that of economics and power politics. Political boundaries and national Governments would continue to exist; but their importance, and especially their importance in causing trouble, would be reduced The risk of conflict between major regions would remain until the time was ripe for world as opposed to regional federation. But the financing of development schemes in the poorer or less advanced countries, and the reduction of economic distress by ironing the bottom out of depressions and by planned schemes for world production and distribution of raw materials and primary products, would remove some of the chief causes of unrest and war

Friction and difficulty will remain. we have the fundamental biological analogy of hostile symbiosis of the parts within the body to remind us of that But man and his societies are organisms, albeit with their own unique nature, and the equally fundamental biological analogy between animal and social evolution shows us that the difficulties can be overcome, and the friction of the parts subordinated to and even utilized for the benefit of the whole

But do not let us delude ourselves into thinking that it will be easy Wishful thinking issuing in impractical schemes is one of man's unique biological attributes Historical experience demonstrates that the most important line of evolutionary progress has been through the improvement of brain mechanism, notably the mechanism for acquiring knowledge and correlating it with action

The corresponding social machinery is yet in its infancy The end of the War will face the world with a task for which it is ill prepared But again, do not let us attempt any ideal or complete plan, any grandiose scheme for which the world is not ripe. That was one of the causes of the League's failure it was an attempt to impose a ready-made plan, and public opinion was insufficiently prepared for any idea of world citizenship Rousseau and the Encyclopædists had been preparing opinion for a radical change in society for half a century; without that, the French Revolution would have been a fiasco. The idea of supernational organization had not penetrated beyond a limited circle of intellectuals, and even they had not had time to work out their ideas in detail, before Wilson sought to impose it in reality. To-day we have at least had twenty years of discussion, together with some bitter if salutary experiences. If the leaders of thought in the various nations can now work out a less pretentious but more workable plan, and at the same time can prepare public opinion for the idea of a dual citizenship, national and world, this War may be the occasion for taking a small but decisive step away from war and towards a world organization of humanity.

CANCER-PRODUCING CHEMICAL COMPOUNDS

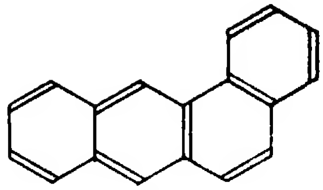
By PROF. J. W. COOK, F.R.S.,
UNIVERSITY OF GLASGOW

IN the last resort, the degree of importance which is attached to the carcinogenic substances depends upon whether such compounds are concerned in the etiology of 'spontaneous' human cancer Perhaps closely bound up with this question is another unsolved problem of outstanding importance, namely, the manner in which these compounds bring about a transformation of normal cells into malignant cells At least until answers are forthcoming to these questions, the carcinogenic compounds will continue to furnish useful material for the experimental study of cancer Industrial cancer, in its various forms, has stimulated the researches which have brought to light the cancer-producing properties of the various carcinogenic agents, and in the preparation of the present brief survey of these agents regard has been paid to the correlation of the various forms of industrial cancer with their causative compounds

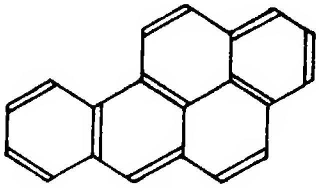
In the earlier work on the carcinogenic properties of substances the skin of the mouse was usually employed as the test object This was due to a number of reasons. Results could be expected comparatively rapidly; the ear of the rabbit, which had been first used, was less satisfactory in this respect Moreover, the modes of application of the substances under examination were considerably restricted by the toxic and inflammatory properties of the crude mixtures which it was necessary to use Many of these difficulties have been resolved by the availability of pure chemical compounds of high carcinogenic potency, and in recent years new techniques of administration have been developed, so that malignant tumours have been induced in a large number of different tissues, and in several different species. One outcome of these and other studies has been the revelation that, in certain strains of animal, tumours of a particular organ are apt to occur spontaneously. Thus, some strains of mice show a high incidence of mammary carcinoma; other strains show a high incidence of lung cancer; and there is at least one strain of mice in which liver-cell cancer (hepatoma) is apt to arise spontaneously. These findings indicate the caution that must be used in interpreting the results when cancers of such organs are found in experimental animals, especially when the tumours arise at sites other than that of application of the carcinogenic agent. Yet even so, tumours clearly attributable to the treatment have been found, usually at the site of application, in a variety of tissues of animals treated with carcinogenic compounds. In this respect the most versatile substances so far found are contained in the group of polycyclic hydrocarbons, mostly related to 1 . 2-benzanthracene (I), in which substituents are present at certain well-defined positions in the molecule With these compounds malignant tumours have been obtained, usually in mice and rats, in such tissues as the skin, the subcutaneous tissues, the peritoneal cavity, the liver, the prostate, the forestomach, the brain, and the spleen, and this list is not exhaustive Less widespread in their effect are members of other classes of compounds, where usually carcinogenic action has not been shown except in a single organ In this connexion it needs to be borne in mind that these substances have not usually been so widely investigated as the polycyclic hydrocarbon class

The earliest form of industrial cancer, recognized as such in the latter part of the eighteenth century, was the cancer of the scrotum to which chimney sweeps were specially liable This was caused by soot, and the pursuit of the clue so provided culminated eventually in the isolation from coal tar of the individual compound responsible. This is 3 4-benzpyrene (II), an aromatic hydrocarbon, the relationship of which to 1 . 2-benzanthracene (I) is apparent from the formulæ 3 . 4-Benzpyrene is undoubtedly the principal cancer-producing constituent of coal tar It has a high boiling point, and hence is present to an appreciable extent only in the highest boiling fractions of the tar. There are grounds for inferring that this or a similar compound is responsible for the carcinogenic properties shown to varying degrees by some of the mineral lubricating oils. Prolonged contact with industrial products of these types is now recognized as being fraught with danger, and the use of suitable precautions should lead to diminution if not to eradication of the form of industrial cancer which they are liable to cause.

The widespread use of tar in road surfaces, and the publication of statistics which appear to show that cancer of the lung is increasing at an alarming rate, have led to the suggestion that tarred road dust may be partly responsible for this increase. This suggestion has been tested experimentally;



(I)



(II)

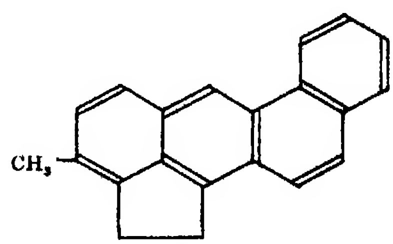
but although an increase in lung cancer was found in mice breathing air impregnated with road dust, this increase was not wholly related to the presence of tar in the dust, and the results of the experiments do not directly implicate such an agent in the increase of the human disease. Furthermore, it is considered by many authorities that the recorded increase in lung cancer is largely accounted for by improved methods of diagnosis. Unconvincing attempts have also been made to implicate pollution of town air by soot, exhaust fumes, etc., and also tobacco smoking in the increase of lung cancer. However, the knowledge that the agencies in question may be, and sometimes are, associated with carcinogenic substances, does not allow such speculations to be too lightly dismissed.

The carcinogenic activity of 3 : 4-benzpyrene is of a high order, inasmuch as tumours arise in a large proportion of the treated animals, in a relatively short time. A somewhat greater potency is shown by 20-methylcholanthrene (III), a hydrocarbon first obtained by chemical transformation of the bile acids, and later indirectly from cholesterol. Other hydrocarbons of similar structure have similar high activity. An altogether higher order of activity, judged by the criterion of shortness of the latent period in the induction of skin tumours in mice, has recently been found in a small group of hydrocarbons typified by 9 : 10-dimethyl-1 : 2-benzanthracene (IV). These compounds, which are characterized by the presence of methyl groups in the positions shown, have in mice skin given tumours which frequently made their appearance within a month of the first application.

It will be observed that the carcinogenic hydrocarbons thus far mentioned are all derived from 1 : 2-benzanthracene (I). A very considerable number of other carcinogenic derivatives of 1 : 2-benzanthracene is now known. These are purely synthetic compounds, not known to be associated with either industrial or naturally occurring products. Their chief interest lies in the large number of closely related compounds which have been shown to have such biological activity, and in the generalizations which it has been possible to arrive at regarding the correlation of carcinogenic activity with molecular structure and with other properties

The benzanthracene group is not the only group of polycyclic hydrocarbons with carcinogenic properties Feeble activity is shown by 3 . 4-benzphenanthrene (V), and systematic examination of homologues and derivatives now in progress is pointing to the conclusion that much enhanced activity is shown when suitable substituents are introduced into positions 1 and 2, but not into other positions of the molecule. Before 3 : 4-benzpyrene had been isolated from coal tar, it had been claimed erroneously that chrysene, also a coal tar constituent, had carcinogenic properties. This error appeared to be due to the incomplete purification of chrysene of coal tar origin These and other circumstances have caused some attention to be devoted to chrysene derivatives, and a number of chrysene homologues, selected in a haphazard way, have been synthesized and found inactive when tested biologically. More recently a consideration of the structural relationship among the carcinogenic derivatives of 1 : 2-benzanthracene and 3 · 4-benzphenanthrene led C. L. Hewett (*J. Chem. Soc.*, in the press) to synthesize 1 : 2-dimethylchrysene (VI), and this hydrocarbon has been found to have definite carcinogenic activity when tested by application to the skin of mice.

For many years it has been recognized that the operatives engaged in certain sections of the



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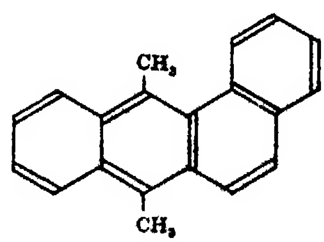
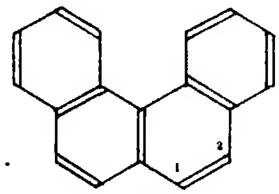


(IV)

chemical industry, and especially in the manufacture of dyestuffs, are more liable to cancer of the urinary bladder than is the general population. This form of cancer was long known as 'aniline cancer', and the prevailing opinion for many years has been that it is due to absorption of nitrogenous bases such as benzidine and the naphthylamines, especially β-naphthylamine. Until recently the evidence was purely circumstantial, and many unsuccessful attempts have been made to induce experimental tumours with these bases. Some two years ago, however, the production of bladder tumours in dogs given, subcutaneously and orally, large daily doses of a high grade of commercial β-naphthylamine was reported by American workers. It was doubtless the prevalence of this dye-workers' cancer, coupled with the known cell-



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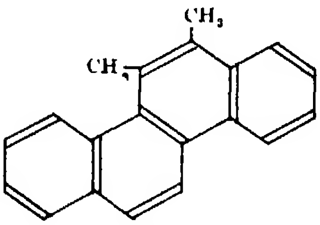
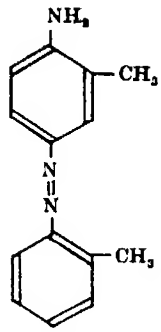


(VI)

proliferating properties of Biebrich Scarlet *R*, which led to Japanese researches which have shown that a number of relatively simple azo compounds have carcinogenic properties. The principal active compounds which have been revealed by this work are 4′-amino-2 : 3′-azotoluene (VII), which gives liver-cell tumours when fed to rats and mice, 2 : 3′-azotoluene (VIII), which gave malignant tumours of the urinary bladder in rats, and *p*-dimethylaminoazobenzene (IX), which is mainly carcinogenic towards the liver

In view of the possibility that contaminants of the naphthylamines might be responsible for the dye-workers' cancer, a number of possible transformation products have been administered to rats and mice in the research laboratories of the Royal Cancer Hospital, London. Mice treated with 2 : 2′-azonaphthalene (X) by application to the skin, or by subcutaneous injection, or by feeding, have developed many liver growths, some of them liver-cell carcinomas, but most were of a cholangiomatous type. Similar tumours were obtained with 2 : 2′-diamino-1 : 1′-dinaphthyl (XI), a product



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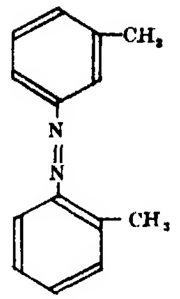

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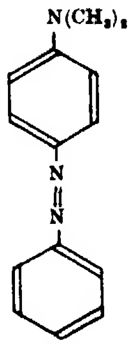
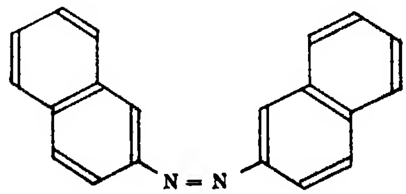


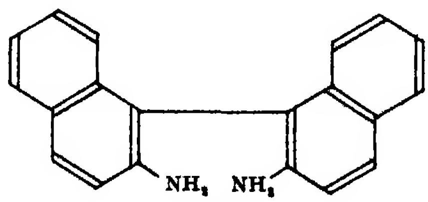
(IX)

which arises easily by intramolecular change of the dihydride of (X), and also with 3 · 4 : 5 : 6-dibenzcarbazole (XII), which is formed by deamination of (XI) There is thus the possibility that the biological effects of this series of compounds are due to a common metabolite, and it is worth noting that the final product of the series (XII) has a structural resemblance to the carcinogenic polycyclic hydrocarbons.

One of the azo dyes found to be carcinogenic to the liver by the Japanese workers, namely, *p*-dimethylaminoazobenzene (IX), was formerly used as a food colouring matter under the name of 'butter yellow' and has also been used in dyeing leather Fortunately, its use in these respects appears now to be obsolete. In Great Britain the range of permitted food colouring matter is now very limited With the co-operation of the Government Chemist, tests have been carried out in which



(X)



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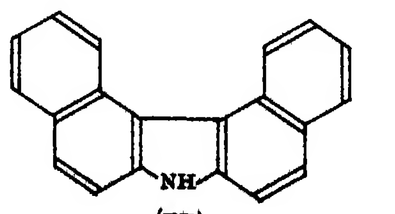

(XII)

relatively large amounts of a selection of these permitted dyes were regularly administered with the food to rats and mice The compounds chosen were azo compounds bearing some structural resemblance to the azo compounds discussed in the present article. They are mostly water-soluble sulphonates, a circumstance which facilitates rapid elimination In a few of the mice stomach tumours were obtained; but it is by no means certain that these were due to the dyes.

Existing knowledge of the structures of the various carcinogenic compounds and of the conditions under which they may be formed has led to various speculations regarding the possibility of such substances being present in human food. Some workers have recorded the production of skin tumours by heated fats and by tars prepared by heating coffee. It has been claimed also that wheat-germ oil prepared by a special extraction process produces sarcomatous tumours in rats This claim has not thus far received independent confirmation, and at the present time there is no evidence that cancer of the internal organs is due to specific dietary constituents However, it is evident that such lines of inquiry should be pursued

A puzzling and in some ways disconcerting feature of the carcinogenic agents now known is their variety and their apparent lack of correlation. It may be recalled that cancer may be induced not only by the classes of compound reviewed in this article, but also by several other agencies. The malignant tumours which arise in consequence of exposure to ultra-violet light, X-rays, and radioactive substances may well be due to the production of carcinogenic compounds from normal constituents of the tissues.

There is, however, no evidence that the radiations exert their influence in this indirect manner. Cancer of the skin occurs in persons taking arsenic by mouth over long periods, and has also been found in workmen engaged in handling arsenical sheep dips Teratoma of the testis in fowls can be induced by injection of zinc salts at the season of the year when the testis is actively secreting androgenic hormone. At other times also this type of growth may be produced if gonadotropic hormone is simultaneously administered, so that at least two factors seem to be involved.

Thus, in carcinogenesis we have a biological phenomenon which may be attributed to a variety of different substances and agencies. This is by no means unique, for the same is true of other biological phenomena; but it is a circumstance which adds to the difficulty of interpreting the biological properties of the carcinogenic compounds and in estimating their ultimate significance.

OBITUARIES

Prof. Sydney J. Hickson, F.R.S.

BY the death of Prof Sydney J. Hickson on February 6 at Cambridge, British zoology loses one of its most distinguished professors He was born in 1859, and was at Manchester from 1894 until 1926, during which he was identified with every aspect of the development of the University of Manchester At the same time he annually contributed to the store of knowledge not only by his special researches on the soft corals, but also by investigations relating to water supplies, hospital sanitation, poultry and many local questions

Hickson was the youngest of a family of nine, most of the older boys of whom were absorbed into the family manufacture of boots and shoes, then situated within the City of London His parents were of Unitarian stock with advanced social views, and among their visitors he recalled Mrs. Besant, Charles Bradlaugh, Auberon Herbert, Charles Voysey and G. T. Holyoake, the last person in England to be sent to prison for blasphemy. This early intercourse left a permanent impression, and Hickson always remained an advanced Whig in public affairs, taking a particular interest in the Land Values League of Manchester. In contrast he was an 'out and out' Tory in his ordinary life, and a friend recalls his top-hatted, athletic figure on its morning walk from Withington to the laboratory.

Hickson's early education was at the Mansion Grammar School at Leatherhead, a beautiful old domain on the River Mole Here he followed his brothers and acquired a taste for Nature, as Ray Lankester had done at the same school. In 1893 he entered University College School, passing on to the College in 1876, where he was so enthralled by Lankester's lectures—the courses commenced at 8 a.m.—that the following year he was Gold Medallist. Then he went on to "Barts", but he found conditions "indescribable and terrifying", Klein's course on histology being to him their one redeeming feature. Lankester advised Cambridge, and there in the laboratories of Michael Foster and F. M. Balfour he found his vocation and made many friends, Sedgwick, Haddon, Bullen, Caldwell, Threlfall and many others. He obtained a first class in the Tripos of 1881; but he had already, by dissecting, teasing and the use of the sliding microtome, begun his laborious studies of the eyes of Pecten and Spondylus; each section was removed and mounted separately by hand, for Threlfall had not yet made his automatic microtome. Similar technique was also employed for his now classical research on "The Eye and Optic Tract of Insects", 1885.

In 1882 Hickson became demonstrator to Moseley at Oxford. His interests henceforth were mainly marine and directed towards those sedentary forms of life upon which his professor had done such brilliant work. He was in Celebes for a year, much of it camped on the shore of Talisse Island; but illness drove him to the higher lands of Makassar, where he studied native life His results are published in "A Naturalist in North Celebes", which is distinguished by its vivid descriptions of shore life In 1888 he was deputy professor at Oxford and in the next year accompanied his uncle, Sir Sydney Waterlow (formerly Lord Mayor of London) on a year's tour of Canada, United States and Mexico. In 1890 he returned to Cambridge as lecturer in advanced zoology. Gadow, Harmer and Shipley were his colleagues in these courses--a highly distinguished team, with Sedgwick to lead them. Each lecturer had his own technique and they were equally successful, for each allowed full play to his own psychology Hickson was the most vivacious. There were gaps in anatomy, relationships and evolution; but his beasts were 'alive and kicking', to his pupils' obvious interest and enjoyment.

Hickson became Beyer professor of zoology at Manchester in 1894, and to the regret of his friends his gaiety was largely eclipsed by that load of executive cares which are inseparable from the life of a professor of science. He succeeded Milnes Marshall, a brilliant zoologist, but a new broom has always dust to sweep away A complete reconstruction of the course for medical students was necessary and teaching collections were deficient The professors repeated their lectures and practicals to strictly segregated women students, and Hickson's refusal to do so brought about the necessary reform At this time general interest in nature study and in science in schools was almost negligible in this busy commercial part of England. The new professor recognized this as a serious detriment to university work and set himself to remedy it, especially advocating nature teaching and school museums Indeed, Lancashire's high position in these respects is largely due to Hickson and the public-spirited men who struggled to remove the financial difficulties which separated the schools from the universities.

The newspapers contain reports of numerous open lectures, especially in connexion with the Manchester Museum, and addresses to 'brotherhoods', excursions and discussions. The City Microscopical Society was his especial interest, and in his turn he was president of the Literary and Philosophical Society. He was a protagonist for the woman students, and the creation of their hall, athletic and other activities was largely due to him; but perhaps he found the most fertile place for his ideals in the development of the Manchester High School for Girls.

On Saturday afternoons Hickson was always to be found on the University Athletic Ground, of which he was the permanent treasurer, often in summer handling a bat. At the same time he was active in all that concerned the governance of the University, being noted for his 'wise' opinions both on the Council and as dean of the science faculty. The growth and happiness of the University was greatly helped by that tradition of hospitality among its professors which his wife loved to foster, little dinner parties followed by good conversation, always humorous. In science it was a distinguished professoriate, including Alexander, Rutherford, Weiss, Elliot Smith, Dixon, Stopford (now vice-chancellor), Perkins, Lamb, Boycott, Reynolds, Loraine Smith and Hopkinson as vice-chancellor

In 1895 Hickson was elected to the fellowship of the Royal Society, mainly on a series of papers elucidating the relationships of the soft corals (Alcyonaria) These became his chief theme of study for the rest of his life and he was universally recognized as the chief authority on them. His last paper dealt largely with the effect of symbionts and is now in the press. They were, too, the subject of his addresses as president of Section D of the British Association in 1903 and as Croonian lecturer of the Royal Society in 1916. In 1926 he retired to Cambridge His mornings were devoted to his research, which, if anything, showed increased mastery, while his afternoons enabled him to display one of the best-kept and varied of small gardens, so different from his Manchester essays in horticulture. He was happy in the past and the present, cared for by his wife, who had been his pupil in his earlier Cambridge days. They had two children, one of whom is a child-specialist at Manchester, while the other, as secretary of the Extension Board at Cambridge, pursues an objective which his father at Manchester advocated forty-five years ago J S GARDINER

Mr. E. N. Nevill, F.R.S.

MR EDMUND NEVILLE NEVILL died on January 14 at his home in Eastbourne at the age of ninety-three. His contributions to science were in astronomy, and his first paper in the *Monthly Notices of the Royal Astronomical Society* appeared in June 1873. This paper was entitled "Note on the Possible Existence of a Lunar Atmosphere", in which he suggested that observations of occultations did not disprove the existence of an atmosphere on the moon. Altogether he contributed about fifty papers to the Royal Astronomical Society and until 1888 he wrote under the name of Edmund Neison, after which he reverted to his family name in accordance with the terms of a will.

Although most of Nevill's work was associated with problems in dynamical astronomy, in particular with those connected with the motion of the moon, he carried out observational work as well. In 1876 his well-known book, "The Moon and the Conditions and Configurations of its Surface", was published, and ten years later he brought out a work with the title, "Astronomy, a Simple Introduction to a Noble Science". Among his numerous contributions to the Royal Astronomical Society may be mentioned an important paper in November 1878 which showed that ancient eclipses indicated a greater value of the moon's secular acceleration than the Arabian observations suggested. He showed that it was possible to effect a reconciliation by postulating a term with a

period of one to two thousand years and a coefficient three or four times that of Hansen's, and he expressed doubts regarding the existence of tidal retardations in the rotation of the earth In a number of other papers he dealt with similar subjects, showing the presence of terms in the moon's motion due to the direct action of the planets, the value of the long inequality due to the disturbing action of Mars, lunar perturbations arising from Jupiter, etc. In the last point he was many years ahead of all other workers in the same field His research in dynamical astronomy was not confined to lunar work and his versatile mind was able to turn to other branches. As one example, reference may be made to an important paper in 1879 with the title "On the General Solution of the Problem of Disturbed Elliptic Motion" An example of his interest in observational astronomy is shown by his work with a Newtonian reflector of 9⅜-inch aperture on the satellites of Saturn He communicated his results to the Royal Astronomical Society in 1876 and dealt with his observations of Titania and Oberon, which he was just able to observe under favourable conditions.

In 1882 Nevill went to Natal to observe the transit of Venus, and as a result of the interest aroused in astronomy, a semi-public observatory was established through the generosity of certain residents in Durban assisted by the Corporation. Later, when this was taken over by the Government of Natal, Nevill was appointed the first director Not only did he carry out the ordinary routine work of the observatory, but he also conducted research in his favourite subject and deduced new values for lunar elements Reference has been made earlier to the results of some of this research. Unfortunately many of his results, including his lunar tables, still await publication. After his retirement from the observatory he does not appear to have done very much work, and the last paper that he contributed to the *Monthly Notices* was in May 1915 entitled, "On the Conjunction of Stars with the Moon, recorded by Ptolemy". He was elected a fellow of the Royal Astronomical Society in 1873 and a fellow of the Royal Society in 1908

Mr. B. D. Porritt

THE death of Mr B D. Porritt, on January 28, came as a shock to his friends despite the long illness that had foreshadowed it

Mr Porritt was born of Yorkshire parents in Canada in 1884, and was educated at the Whitgift Grammar School, Croydon; at University College, London, where he graduated in chemistry in 1908; and at Heriot Watt College, Edinburgh. He joined the North British Rubber Co, Ltd, where he was chief chemist in 1912 and research superintendent in 1916. He left the Company in 1920 to assume the directorship of the Research Association of British Rubber Manufacturers, then inaugurated under the co-operative research scheme of the Department of Scientific and Industrial Research.

The chemistry and physics of the rubber industry in 1908 was much more primitive and ill-informed than to-day, and Mr. Porritt had a wealth of problems before him from the beginning. In the early years, he made useful contributions to analytical and testing methods for rubber. This interest continued throughout his life, for in later years he concentrated an enormous amount of fine detail work on the standardization of testing methods, and was a leading spirit in establishing the Rubber Industry Committee of the British Standards Institution

Observations of a more fundamental nature were made, as early as 1920 21, on the then unsuspected photopolymerization of rubber solutions, and on the role of oxygen in the mastication of crude rubber. Both these subjects have since received much development in other hands.

Another early interest, which he was able to pursue at length for himself, was the study of the surface breakdown of hard rubber under the influence of light. He contributed also many observations on the swelling of rubber in non-aqueous liquids and on the factors influencing that obscure phenomenon. One of his last interests was the production of crude rubber in the form of fine powder, and the utilization of the new product in novel processes.

By way of a hobby, Mr Porritt was the British rubber industry's historian, and his "Early History" has long been the classic source for all subsequent writers in this particular field.

The story of B. D Porritt would be quite incomplete without stress being laid on his tireless work in promoting co-operative research He commenced in and with the Rubber Research Association when the industry's interest was so lukewarm that only fifteen member firms supported the idea; he left it at his death with more than 170 member firms. This progress and success was due mainly, if not wholly, to his untiring efforts in promoting the co-operative principle, and to the sound work of the organization which he built up. His flair for organization, indeed, extended in many directions. He made a notable success of the Rubber Exhibition at the London Science Museum in 1934-35, and was a leading promoter of the Rubber Technology Conference of the Institution of the Rubber Industry in 1938.

He was author of a small book, "Chemistry of Rubber", in 1913, and co-author of the now well-known reference handbook, "Rubber, Physical and Chemical Properties", in 1935

T. R. DAWSON.

WE regret to announce the following deaths:

Mr. K. E. Heesom, inspector of mines, Sierra Leone, on February 11, aged forty years.

Prof. J. H. Michell, F.R.S., professor of mathematics during 1923–1928, and honorary research professor of mathematics since 1928 in the University of Melbourne, on February 3, aged seventy-six years.

Prof. E. Soler, emeritus professor of theoretical geodesy in the University of Padua, vice-president of the International Association of Geodesy, on January 24.

Prof. Margaret Floy Washburn, professor of psychology at Columbia University, author of "The Animal Mind", aged sixty-eight years.

NEWS AND VIEWS

American Association: New President

DR. ALBERT FRANCIS BLAKESLEE, director of the Carnegie Institution Station for Experimental Evolution, Cold Spring Harbor, U.S.A., has been elected president of the American Association for the Advancement of Science. This election will be welcomed all over the world, because he has a high reputation as a botanist and as a pioneer in more than one line of research, while his genial manner and ever-ready help to all scientific workers are very well known. His early work, in which he showed that only individuals of a fungus species which were physiologically different could take part in sexual union, initiated a large number of investigations into the behaviour of sexuality in the fungi.

Later, in collaboration with a number of workers he had attracted round him, Dr. Blakeslee analysed the cytogenetics of the thorn-apple, *Datura Stramonium*. The discovery of secondary and tertiary trisomics, and the analysis of their constitution by Blakeslee and Belling was a turning point in modern genetics. Studies of tetraploid segregation in Datura, the production of many haploids and novel chromosome types and the analysis of the effect of changes in the chromosome constitution of a plant by Blakeslee are established as classical reference material. More recently he has been a leader in the utilization of colchicine treatment in the production of polyploid forms. Results of economic importance are already being produced, while a neat use of colchicine is being made for the elucidation of sex-determination in plants. Dr. Blakeslee's wide interests are appropriate to the presidency of the American Association.

University of Cambridge Parliamentary By-election

THE recent by-election in the University of Cambridge to choose a successor to the late Sir John Withers in the House of Commons was of unusual personal interest to scientific workers in that the two candidates must be well known to many of them. Prof. A. V. Hill, Foulerton research professor of the Royal Society, formerly Jodrell professor of physiology in University College, London, has been one of the secretaries of the Royal Society since 1935. Prof. John A. Ryle, regius professor of physic at Cambridge since 1935, has had a distinguished medical career in London, and recently completed a four-year term on the Medical Research Council. Both candidates adopted the adjective 'independent', and while Prof. Hill accepted the support of the Cambridge Conservative Graduate Association, Prof. Ryle preferred to style himself 'progressive'. Prof. Ryle's advantage as a Cambridge resident was offset by the fact that Prof. Hill, as a former scholar and fellow of Trinity College, is well known in Cambridge.

The result of the poll was declared on February 24: Prof. A. V. Hill, 9,840 votes; Prof. J. A. Ryle, 5,386 votes. Prof. Hill therefore goes to Westminster as one of the Parliamentary representatives of the University of Cambridge. In his election address, he claimed the independence usually accorded to university members; in addition, he stressed the importance of international co-operation in attacking the problems which will face the world at the conclusion of the War. He also urged the need for bringing science and learning to bear on national affairs, and said that "science has still too little influence on higher policy in government, in departments and in industry". As regards the universities, their strength must be maintained; industry will require new methods and materials in the recovery phase; improvements in public health must be studied; trained and critical young minds will be needed to meet the problems of reconstruction; and finally, the "free pursuit of knowledge for its own sake must be kept up". Prof. Hill's programme is comprehensive, but no one who knows him will doubt that he will press his views at the proper time with skill and vigour.

Heinrich Wilhelm Matthias Olbers (1758–1840)

ON March 2 a century ago, the city of Bremen lost its most distinguished citizen, the physician and astronomer Heinrich Wilhelm Matthias Olbers, who died at the age of eighty-one years, after a life of unremitting industry. He was born on October 11, 1758, at the village of Arbergen, near Bremen, where his father was pastor, and from his boyhood he was an enthusiastic student of science. When nineteen he became a medical student at Göttingen and at twenty-three set up in practice in Bremen. A conscientious practitioner, he served his fellow-citizens in many ways, and after his death his statue was erected in the city. His astronomical work was done in the upper part of his house in the Sandgasse, which was fitted up to afford a view of the greater part of the sky. His instruments included a 5-ft. Dollond refractor of 3¾-in. aperture, a 5-ft. reflector by Schröter, a quadrant by Bird and a Troughton sextant. It is said that he never slept more than four hours at a time.

Olbers is chiefly remembered for his discovery of asteroids and his fifty years' study of comets. In 1772 Bode had discovered the law of planetary distances bearing his name, and when in 1781 Herschel discovered Uranus it was concluded that there was a planet between Mars and Jupiter, and largely through Von Zach, in 1798 a party of astronomers met at Gotha to start a search for it. Another meeting took place at Schröter's observatory at Lilienthal, and zones of search were assigned to twenty-four astronomers. One of these astronomers was Piazzi of Palermo, but before instructions reached him, on January 1, 1801, he

discovered the minor planet Ceres The search being continued, Olbers, on March 28, 1802, discovered Pallas, on September 1, 1804, Harding discovered Juno, and on March 29, 1807, Olbers discovered Vesta. The fame of Olbers spread far and wide He represented Bremen at the baptism of Napoleon's son the King of Rome in 1811, and during 1812-13 was a member of the legislative body in Paris The Royal Society elected him a foreign member in 1804, and the Paris Academy of Sciences in 1829 made him a foreign associate He was the correspondent of nearly every astronomer in Germany, and through him Bessel became known in the scientific world Indeed he declared that his discernment of the genius of Bessel was a greater service to astronomy than his own work on comets and planets He was a man of lovable disposition, generous and unassuming

Laurent Théodore Biett (1781-1840)

DR LAURENT THÉODORE BIETT, a celebrated Paris dermatologist, was born in 1781 at Schams, in the Grison canton of Switzerland Seven years later he moved with his parents to Clermont-Ferrand, where he commenced his medical education under Bonnet, the senior surgeon to the Hôtel Dieu At the beginning of the century he came to Paris, where he qualified in 1814 with a thesis entitled "Quelques Observations sur la frénésie aiguë idiopathique" Shortly after qualification he was appointed physician to the Hôpital Saint Louis, where he carried out some important improvements, including the establishment of an out-patient department for diseases of the skin, of which he was the director for sixteen years While attending a patient in London in 1816, he took the opportunity of studying the work of Willan and Bateman, and on his return to Paris endeavoured to introduce their classification of skin diseases, which was in opposition to that drawn up by his friend Alibert

Biett made many valuable contributions to the treatment of skin diseases, including the use of iron and arsenic internally, the employment of sulphur baths and the application of dry and hot air His lectures, which were edited by Cazenave and Schedel, appeared in 1828, went through three editions, and were translated into English in 1842 by T H. Burgess He also contributed many articles to the "Dictionnaire des sciences médicales", and all the articles on diseases of the skin to the twenty volume "Dictionnaire de médecine", in addition to papers in periodical literature such as the *Bulletin de Thérapeutique*, *Gazette des Hôpitaux* and *Journal universel des sciences médicales* Being a devotee of the arts, he was the medical attendant of many well-known painters, sculptors and actors He died of heart disease on March 3, 1840

Colonial Development and Scientific Research

PUBLICATION of the recommendations of the West Indies Royal Commission together with the important statement of policy on colonial development and welfare (H.M. Stationery Office. Cmd. 6174, 6175), to which Mr. Malcolm MacDonald, H.M Secretary of State for the Colonies, made reference in the House of Commons on February 20, mark a momentous enlargement in scope in the administrative and financial relations between Great Britain and her colonial and other dependencies of analogous status which will have a profound effect on their future. The measures which the Government now proposes after an examination of Colonial problems which had been begun sometime before the outbreak of the War is an acceptance of an obligation which has long seemed inevitable to those who have been engaged in the scientific investigation of conditions in these dependencies if Great Britain's responsibility is to be met.

In brief, the proposals are as follow: The place of the Colonial Development Fund, instituted in 1929, and limited to a sum of £1,000,000 a year, will be replaced by a greatly increased provision for development and welfare The sum will amount to not more than £5,000,000 a year for a period of ten years, at the end of which period this provision is to be reviewed The amount thus made available, is not, however, from one point of view the most important enlargement On one hand, assistance will no longer be granted, as hitherto in the main, solely to capital expenditure, but recurring expenditure will come under this provision On the other hand, while certain purposes of expenditure have not been ruled out in terms, assistance has been granted generally to material development In future this will not obtain, and such services as agriculture, health, education and housing will be brought into the account

Nor are the claims of the important question of research overlooked Hitherto, as Mr. MacDonald pointed out, the Colonial Office has been able to call upon the assistance of scientific and technical experts in dealing with Colonial problems This service will now be placed upon a permanent basis by the institution of a Colonial Research Advisory Committee, while for dealing with its recommendations a sum of £500,000 a year will be allocated. This will be used to assist in the various fields of research. As already mentioned, these proposals apply not only to the Colonies and Protectorates, but also to the Mandated Territories. The pause, which, as Mr. MacDonald intimated to the House of Commons, must ensue before they can come into full operation, will give the necessary breathing space for the careful preparation of plans

Tibetan Coronation

IT is perhaps not surprising that, even amid other and insistent preoccupations, the accounts of the final act of the installation of the new Dalai Lama sent by correspondents to the world's daily press, have created a profound impression Nowhere else, except possibly in Japan, could the inauguration of a new head of the State have so closely wedded the spiritual and the political and civic elements in what is virtually an act of coronation, and at the same time united every member of the population in an expression of combined loyalty and religious fervour.

Throughout the pageantry, the wealth and splendour of display of personal adornment, dress, and equipment vividly described in, for example, the dispatches of the correspondent of *The Times* in the issues of February 23 and 24, there is apparent an all-embracing current of mystic symbolism which endues every act, every movement and every attendant circumstance with the significance of worship, and of recognition of the spiritual influence which centres in and emanates from the person of the reincarnated head of the Tibetan spiritual and political hierarchy. It is this, and not the fact that such ceremonial has not been enacted in Lhasa for the space of sixty years, which animated the crowds through which the Dalai Lama was carried in his golden palanquin to the Potala, and on the following day added a solemn meaning to the blessings of a child conferred on the elders of church and State and later sanctified what was otherwise an unseemly scramble for the Dalai Lama's food as a re-enactment of the ancient ritual of sharing in the flesh of the sacrificial victim

Relics of the Buddha

BUDDHISM of another order, but nevertheless of a closely related world of thought, appears in the announcement that Buddha relics of exceptional sanctity, discovered in Central India nearly ninety years ago and since in private possession in England, will now return to the East They have been given to a Buddhist Temple in Ceylon by Mrs Leslie Smith and Mrs Winifred Burrows, granddaughters of General F. C Maisey, by whom they were discovered when with Sir Alexander Cunningham he was investigating the numerous Buddhist monuments around Bhilsa in 1851 The discovery, as described in *The Times* of February 27, consisted of a relic casket a small crystal tope, with terrace, plinth, hemispherical dome, square pedestal and a double pinnacle, this last forming the stopper of a small perpendicular shaft This casket has been dated at about 350 B C The relic chamber at the bottom of the shaft contained minute pieces of bone, the whole being enclosed in a red earthenware box, which also contained other pieces of bone, and a series of the seven precious things usually accompanying the relics of an eminent person, namely, thin round pieces of gold, a bead of garnet, a crystal bead, two beads of pale greenish crystal, and some minute fragments of pearl

The casket is now in the India Section of the Victoria and Albert Museum, South Kensington; but a cast and photographs have been supplied by the authorities in order that a replica may be made in Ceylon by native craftsmen. The relics and the seven precious things, which were retained by General Maisey when he presented most of the antiquities to the Museum, have now been enclosed in a carved silver tope from Ceylon for their conveyance to the island.

Sutton Hoo Burial a Cenotaph?

IN an account of the excavation of the Sutton Hoo ship-burial and of the associated antiquities delivered before the Society of Antiquaries of London on February 22 (see NATURE, Feb. 10, p. 231), Mr C. W Phillips referred to the remarkable feature of the deposit that it did not accompany a body. The explanation which he put forward on certain grounds was that the mound and its contents as a whole had the character of a cenotaph for a great man whose body could not be recovered, possibly through being lost at sea One suggestion which has been offered, namely that it may have been a measure of insurance on the part of a recently Christianized pagan in an endeavour to make the best of both alternatives, is perhaps not to be taken seriously Nevertheless survival of a pagan ritual, even in such an essential rite as burial, cannot be ruled out entirely, and it receives a certain amount of support from the archaic character of the ship, of which some further account was given

The excavation of the ship was under the direction of Lieutenant-Commander J. K D Hutchinson of the Science Museum, South Kensington It proved to be a remarkable vessel in the form of an open barge, clinker-built, keel-less, and propelled by at least thirty-eight oars It was described as a development of a type already known to archaeologists, and, it may be supposed, of a type already archaic at the time of its burial In its character as a royal barge, a comparison was instituted with the position of the royal yacht *Victoria and Albert* among contemporary shipping. This view would accord with the interpretation of the find which emphasizes its highly ceremonial nature At the same time it may be recalled that ship models found by the Danish Thule Expedition to Greenland pointed to Norse ships still being in use of which the essential features had remained unchanged for a period of nearly six hundred years

Cosmic Rays

THE twenty-fourth Guthrie Lecture of the Physical Society was delivered by Prof. P M S Blackett on February 26 He took as his subject "Cosmic Rays: Recent Developments" He said that the most important discovery of recent years in the field of cosmic rays was the realization that the hard or penetrating component of the rays consists of particles of a new type, called mesotrons. This new particle has a mass intermediate between that of the electron and the proton and possesses the peculiar property of being spontaneously unstable. Its average life when at rest is about one millionth of a second, but when moving fast it lives longer—thus giving a nice verification of Einstein's principle of relativity

The rays incident on the earth's atmosphere are of very great energy. Recent work shows that some of the rays have an energy certainly as high as one thousand million million volts. This is an astonishingly great energy, and it is probably not the limit. It is quite likely that rays exist with energy as high as a million million million volts or even more. Particles of such great energy have very peculiar properties. Instead of producing a narrow track of ionization a fraction of a millimetre broad like normal atomic tracks, they make a track many metres broad. This is deduced from relativity theory, but has not

yet been verified experimentally. Great interest is attached to the 'spectrum' of the rays incident on the earth's atmosphere, since they should give some light on a possible origin for the rays. It is rather remarkable to find that the spectrum of the rays can be represented roughly by a simple power law over a range of energy of above a million to one. More precisely, the number of rays with energy greater than some given value is roughly inversely proportional to the square of the energy, over the energy range from a thousand million to a thousand million million volts. It can scarcely be doubted that this remarkable law must have some profound, but at present unknown, cosmological significance

Fuel in Science and Practice

THE monthly periodical *Fuel in Science and Practice* has completed eighteen volumes since it was launched as a supplement to the well-known mining journal *Colliery Guardian* It was established on the initiative of the Coal Research Club in order to provide a medium of communication for those interested in the scientific study of fuel, and coal in particular. It was the first journal of its kind in the English language and has proved very successful, the success being doubtless due in a large measure to the efforts of its first editor, the late Prof. R. V. Wheeler. The first number of the nineteenth volume has now appeared under the editorship of Dr. R. Lessing, who has been associated with the venture since its inception. This, it may be taken, will ensure continuity of policy. It will continue to aim at providing a clearing-house for the results of investigations and a bridge between the science and practice of fuel technology.

The Institute of Fuel has decided to adopt *Fuel* as its research journal for the benefit of its members who wish to be kept informed of the results of recent investigations into coal and other combustibles. The Coal Research Club, assisted by an editorial committee, will continue to direct its policy and ensure the maintenance of its old and successful traditions. It seems probable that the importance of fuel technology for some years to come will ensure a prosperous future for this journal. At the same time, it is pertinent to recall the unsatisfactory state of the documentation of science. While it appears relatively easy to publish journals containing interesting articles, the thankless task of publishing systematic abstracts is a growing burden the support of which meets steady reluctance.

Coal-Gas and Fuel Research at Leeds

PROF. D. T. A. TOWNEND, who succeeded Prof. J. W. Cobb as head of the Department of Coal-gas and Fuel Industries and Livesey professor in the University of Leeds, has now issued his first report, covering the session 1938–39, to his Advisory Committee. He takes an opportunity therein to pay a tribute to the late Prof. Smithells, who died during the term under review and who was a member of the Committee from the time of its formation. To him also was due, more than to any other man, the formation of the Fuel Department in the University and, a few years later, the establishment of the Livesey chair by subscriptions from the gas industry.

In the body of the report, Prof. Townend reviews in turn the varied activities of his department, which has developed in several directions, not only fuel and gas engineering, but also the cognate subjects of refractory materials and metallurgy, in both of which teaching and research have made much headway. A post-graduate diploma in fuel and refractory materials has been instituted along similar lines to those already given in gas engineering and in fuel and metallurgy. The first opportunity will be taken to give a more systematic course in chemical engineering, which is, in effect, so largely the subject of the departmental teaching Research continues to be supported by the gas industry and the Iron and Steel Institute. Prof. Townend is continuing work on flame, which had engaged him in London, and independent research work carried out by the staff and students continues to be a marked feature of the departmental activity.

Modern Colour Printing

IN the *Electrical Review* of February 2, an illustrated description is given of some of the new equipment installed by Geo. C. Caster and Co., Ltd., commercial and colour printers, who recently transferred their works to Cromwell Road, Peterborough. In accordance with modern practice the factory has been set out on a single floor, with a planned layout for the speedy handling of work and an uninterrupted continuity of production. There is no shafting, and individual direct electric drive is employed on all machines. One of the large high-speed letterpress machines is a two-revolution Miehle capable of a maximum output of 3,000 sheets, 25 in. by 40 in., per hour. Another large two-revolution machine takes bigger sheets (30 in. by 40 in.) and can print 2,300 sheets per hour. For small sheets up to 13½ in. by 20 in. vertical Miehle machines are brought into service. These are specially suitable for high-class colour printing. A maximum of 4,500 prints an hour can be handled by each machine.

The use of a general lighting system of high intensity throughout the factory makes local lighting unnecessary (except under the machine boards). In the composing room an illumination intensity of 35 ft.-candles at the working plane is obtained with Benjamin reflectors, which are also used in the binding department to provide 10 ft.-candles. To facilitate the matching of ink colours, daylight reflectors have been installed in the machine department to give 14 ft.-candles.

The Achromatic Lens

THE contributions made to *Lychnos* during the last two years by Drs. N. V. E. Nordenmark and J. Nordstrom dealing with the invention of the achromatic lens and the part played by S. Klingenstierna, professor of mathematics at the University of Uppsala, in the process, have been issued as a pamphlet by Almquist and Wiksells, Uppsala, with an English summary. Many of the original documents bearing

on the history of the invention are reproduced with illustrations. One of the most important is Ramsden's Royal Society paper of June 18, 1789, from which it appears that Chester Moor Hall had an achromatic object glass ground for him in 1732 or 1733 and that achromatic telescopes were made for him by the Strand optician J. Bird. The patent for the construction of such lenses from crown and flint glasses was taken out in 1758 by J. Dollond but no calculations were given, probably owing to the desire to keep the theory from other opticians. Klingenstierna worked out the theory, published it in the Transactions of the Swedish Academy in July 1760 and sent a copy to the Royal Society, which published it, although Dollond stated that it contained nothing which he had not done himself previously.

Early Agricultural Tractors

MR. R. H. CLARK, in the *Engineer* of February 2, under the title "Some Early Burrell Engines", recalls an almost forgotten chapter in the development of steam traction engines, built mainly for agricultural work. In 1846, James Boydell took out a patent for his "Endless Railway", and eight years afterwards patented improvements on it. His ideas were taken up by Charles Burrell and Co., a firm of country engineers established at Thetford in 1770, and in 1856 the first road locomotive was constructed embodying the principle of the "Endless Railway". The general arrangement of the traction engine was much as that familiar a few years ago, but each of the wheels, instead of running on the surface of the road or field, ran on a series of flat shoes which in succession were brought into position by links and pins attached to the wheels. There were six shoes to each wheel.

This arrangement of shoes allowed the engine to move over the roughest roads and over soft and marshy ground. One of the illustrations shows an engine drawing four two-furrow ploughs. In 1857 a Boydell engine drew a load of nearly 44 tons from Bury St Edmunds to Woolwich Arsenal at an average speed of 3·1 miles per hour. The cost of transport was 2*d*. per ton per mile against 6*d* if horses had been employed. Boydell engines were apparently being built up to 1868, when they were abandoned for engines with ordinary wheels.

Prevention of Diphtheria by Immunization

ABOUT 60,000 cases of diphtheria, chiefly among children less than fifteen years of age, are notified annually in England and Wales, with some 3,000 deaths. Yet it has been shown, particularly in certain cities in Canada and the United States, that by artificial treatment or immunization the disease may be practically banished. The Minister of Health has therefore issued an official memorandum urging that artificial immunization should be undertaken by county councils and sanitary authorities (Memo. 170/Med. H.M. Stationery Office. 1*d*. net). It is suggested that the immunization should be undertaken as early in the child's life as is practicable and should form an integral part of the work of child welfare centres. The Memorandum gives technical details of the procedure and of the various forms of diphtheria prophylactic used, and of the need for Schick testing after treatment to ascertain whether this has been successful.

Lice

THE Minister of Health has recently issued a "Memorandum on the Louse and How to Deal With It" (Memo 230/Med , 1940) Its publication comes at an opportune moment, when experience of evacuation has brought the louse problem into prominence. In the event of serious air raids large bodies of people may have to be removed to other districts. This, in itself, is liable to cause the spread of lice to localities, or among people, previously free from infestation Ample powers are available under the Education and Public Health acts for the application of suitable control measures, and it is to be hoped that public medical officers and other officials will do all possible to reduce what has long been a standing menace to proper living conditions. Copies of the memorandum may be purchased directly from H.M. Stationery Office, or through a bookseller, price 2*d*. net.

Vitamin E

REFERENCE was made in NATURE of December 16, 1939, p 1008, to a solution of vitamin E now available commercially. Glaxo Laboratories Ltd. put on the market in 1933 capsules of wheat-germ oil extract (thirty times as potent in vitamin E as wheat-germ oil itself). The capsules were given the name 'Viteolin' in 1937. Viteolin was the preparation used by Currie and M'Gonigle in their published clinical trials which confirmed in Great Britain the value of vitamin E in the treatment of habitual abortion. With the availability of vitamin E as a chemical substance (tocopherol) each 'Viteolin' capsule has been standardized to contain the vitamin E potency of 6 mgm. of tocopherol, the potency clinically established as the desirable daily dosage.

Institute of Physics and Freedom in Science

THE Institute of Physics has sent the following letter signed by its president, Prof. W. L. Bragg, to the Polish Ambassador: "On behalf of the Board of the Institute of Physics I have to convey to you, and through you to your Government, the deep sorrow with which British physicists at home and overseas have heard of the forcible closure of the Institute of Physics in Warsaw, the dispersal of its eminent staff and the confiscation of its valuable equipment. Our sympathy goes out to our Polish colleagues in this interruption of their labours for the progress of our science, and in the tragic and unmerited hardships and perils which they are enduring. We look forward to the time, which we pray may not be far distant, when, restored to its former freedom, the Institute of Physics in Warsaw shall once again take its place among the great scientific institutions, and continue its work for the advancement of learning, and the welfare of mankind."

British Museum (Natural History)

IT has been decided that the British Museum (Natural History) shall be open to the public every afternoon from 1 until 5 p.m. beginning on February 28, and it is intended after Easter that the Museum shall be open all day from 10 a.m. until 5 p.m. Certain galleries only are available, and the present restrictions will continue to apply to the number of visitors and to the admission of children unaccompanied by adults.

The Department of Botany has received about seven thousand specimens as a result of an expedition to the Outer Hebrides (Lewis and Harris) organized during the past summer by Miss M. S. Campbell. Miss Campbell was accompanied by Dr. J. W. Campbell, Mr. C. V. B. Marquand, and Messrs. A. J. Wilmott, E. B. Bangerter and J. A. Crabbe of the Department of Botany. The collection is fully representative of the summer flora of the areas visited. Dr. R. Scott Russell has returned from a botanical expedition to the Karakorum Himalayas. The expedition, which would otherwise have continued into 1940, was cut short by the outbreak of war and only the collecting planned for 1939 was carried out. The number of gatherings made was 870, and the specimens collected have been left at Kashmir to be forwarded to the Museum later.

Earthquakes in Turkey

ACCORDING to a *Times* message, the final official figures for the Turkish earthquake of December 26 are 32,741 killed and 9,404 injured. It is also reported that it has been decided to rebuild Erzinjan slightly to the north of the old town and that construction is beginning.

Aftershocks of the earthquake still continue with considerable severity. Between 3 a.m. on February 21 and noon on February 24 another 300 people were killed, many more injured, and more than 10,000 head of cattle perished in addition to six villages being completely destroyed. The earthquakes commenced about 3 a.m. on February 21, and before 5 a.m. there had been eight severe shocks. The epicentres appear to have been near the village of Soysalli, near Kayseri in Central Anatolia, some 150 miles south-east of Ankara. Soysalli and three other villages were completely destroyed and the shocks were sufficiently intense to have been felt in eleven districts and many towns, including Ankara, Istanbul, Smyrna, Konya and Adana. On February 22 there were six more shocks and on February 23 and 24 the shocks continued with decreasing severity. In spite of the intense cold which still prevails in this part of Turkey, many people are preferring to live in tents.

Problems of the Industrial Scientist

A CONFERENCE on "The Problems of the Industrial Scientist" convened by the Association of Scientific Workers and the British Association of Chemists, will be held on March 9, commencing at 2 p.m., in the lecture hall of the Pharmaceutical Society, 17 Bloomsbury Square, W.C.1. All scientific workers and others interested are cordially invited to attend and participate. Prof. F. G. Donnan will be in the chair. Mr. Hugh Linstead, of the Pharmaceutical Society, will open the proceedings with a general survey of the problems of scientific workers employed in industry. This will be followed by a series of short papers and discussions. At the conclusion of these discussions, Prof. J. D. Bernal will sum up the discussion as a whole, and the conference will then consider the possibility of adopting a 'programme' for scientific workers in industry. Similar conferences are being held at Liverpool, at 6.30 p.m., on March 4, at 5–6 Bluecoat Chambers, Liverpool, 1; Manchester, at 3.0 p.m., on March 16, in the Chemistry Lecture Theatre, the University; Birmingham, date to be announced later. Following the regional conferences, it is intended at a later date to hold a National Conference to review the data and resolutions resulting from them, and to decide on the final form of the 'programme' and on steps to be taken to work for its acceptance. Further information can be obtained from the Secretary, Association of Scientific Workers, 30 Bedford Row, W.C.1.

Announcements

THE British Association is arranging a conference on "Science in National and International Aspects", to be held at Reading during July 24–26. This will take the place of the ordinary annual meeting which would in normal circumstances have been held at Newcastle.

MR. ASA BINNS, until recently chief engineer of the Port of London Authority and now a consultant to the firm of consulting engineers, Messrs. Rendel, Palmer and Tritton, has been elected president of the Institution of Mechanical Engineers for the year 1940.

DR. LOUIS MARTIN, director of the Pasteur Institute of Paris, has succeeded General Sieur as president of the Academy of Medicine of Paris.

THE Council of the Royal College of Surgeons of England has undertaken to organize a library at the medical base in France for the use of the officers of the Royal Army Medical Corps.

THE Oxford Ophthalmological Congress will be held at Oxford on July 4–6. Prof. Le Gros Clark will deliver the Doyne Memorial Lecture, and there will be a discussion on "Emergencies and Complications of the Operation for Cataract".

THE Board of Education has just published a "Handbook of Suggestions of Health Education" (H.M. Stationery Office. 6*d* net). The book is issued primarily for the benefit of teachers, and covers most aspects of health education, and incorporates recent advances in the science of nutrition.

ERRATUM. Letter by Dr. D. Roaf entitled "Energies of β-Particles from Uranium-X_2" in NATURE of February 10, p. 223, the numbers along the $H\rho$-axis in Fig. 2 should read: 0, 5000, 10,000.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 351. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radium Treatment

SIR LEONARD HILL returns in NATURE of January 27, p. 151, to his statement "that we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there", and seeks to make good this assertion by reminding us of some of the casualties of radiological practice He has allowed these examples to stay in the forefront of his mind, instead of fitting them into the groundwork of experience, which every practising radiologist must do

The dangers attending the use of radium and X-rays have been the concern of the X-ray and Radium Protection Committee for many years No Committee can possibly safeguard a patient against an unskilful application of rays, but radiologists have striven to limit such dangers by making a real specialty of their subject, and there are at present five universities or kindred bodies in Great Britain which grant medical diplomas in this subject. The subject has, indeed, reached a status where its exponents can afford to ignore the rather baser charges in question, but the dis-service of Sir Leonard is to the public, who pay undue attention to his *ex cathedra* statements.

It is not true that the 15,000 patients (mostly cancer patients) who received radium treatment in Great Britain during the year 1938 had such treatment because of the vested interests of the medical public; the vast majority had radium treatment because it was considered the best available for them It should be remembered that more than 90 per cent of the country's radium is held by big organizations, such as the Radium Commission, the King's Fund and the Medical Research Council; this is some guarantee that it is used by people of responsibility

Sir Leonard would like to see "the use of radium or X-rays being reserved for one or two places in the body where surgical operation is very difficult" The publication "Medical Uses of Radium" has been issued yearly since 1922 by the Medical Research Council, and the Radium Commission has in recent years made annual reports on the results of treatment; from them the pertinent fact emerges that the medical profession continues year by year to treat various forms of cancer at many sites of the body, and there is a disposition to widen rather than restrict the field As for radium in the boreholes, it is only right that the public should know that much of the radium put away for safety has now been brought into use for their treatment.

SIDNEY RUSS.

Barnato Joel Laboratories,
Middlesex Hospital,
London, W.1.
Feb. 6.

SIR LEONARD HILL writes, in NATURE of January 27, with reference to radium treatment and expresses a belief that "we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there . " This pessimism contrasts notably with the enlightened optimism of the article, in the same issue, written by Dr John H. Lawrence, of the University of California, who is working with great opportunities at present lacking in Great Britain Lawrence and his co-workers are pursuing "the possibilities of artificial radioactivity and neutron rays in cancer therapy until a more satisfactory answer to this problem has been reached" What we require in Great Britain is a well-organized radiological institute where the various possibilities of radiation can be developed and extended It had always been my hope and ambition that such an institute would be founded as a memorial to Lord Rutherford, who was always wide awake as to the possibilities of radiotherapy and the proper means by which they could be furthered or achieved

Sir Leonard Hill has collected a certain amount of gossip about radium and narrates a few cases of failure due to the misuse of radium which have come to his personal notice To counterbalance his citation of deplorable failure, I could quote instances in my own experience where men with cancer of the throat, and elsewhere, have been treated by radium and returned in full health and happiness to their useful work and daily life

It is admitted by all that the cause, prevention and cure of cancer have not yet been attained In some cases, when early treatment has been given, there has been cure or palliation by three chief means, surgery, radium, X-rays All three methods can be and have been grossly abused in some cases, but wisely applied in a vast number of instances. It is not proposed to abolish railway signals because a signalman has wrecked a train by pulling the wrong switch; the effort is made to improve the arrangement, to make it fool-proof, to have an efficient block system. Surgery is not condemned wholesale because of occasional deaths by incapacity, ignorance or carelessness. There have been deaths from dressings or swabs left in the wound. The wrong gas has been administered as anæsthetic. Overdoses of morphia have been given. A man can cut his throat with a safety razor. All such mistakes are no justification for complete disuse of the means employed.

It is, however, necessary to answer Sir Leonard Hill's ill-timed statement in a more positive sense, always remembering that while surgery has been under the guidance of men of high skill and intelligence for centuries—of men provided with every facility—on the other hand, both radium and X-rays are recent discoveries and naturally their applications to therapy are yet in their infancy.

A system of properly controlled and measured dosage, which can be repeated at will with exactitude, has scarcely yet been fully evolved. Certainly, in the past haphazard applications have produced deplorable results, but these are now avoidable in consequence of the research work already done on the proper direction of the radiation and on the determination of the magnitude of the dosage delivered to the growth and to the surrounding tissues.

Sir Leonard raises the question of the relative merits of radium and of X-rays and settles the matter to his own satisfaction with a positive assertion in favour of X-rays. In no part of the world has this difficult question yet been answered with sufficient scientific evidence to admit of certainty. The same uncertainty prevails as to the rival merits of X-rays of various voltages and wave-lengths. We may conjecture, but we cannot assert Indeed these two important questions are forming part of an investigation by the Radium Beam Therapy Research under the Medical Research Council, and it is a matter for deep regret that this important work should be temporarily suspended by the exigencies of war

Some of my well-informed friends point out to me that, in the case of cancer of the uterus, Wertheim's operation for the removal of the whole organ has been given up by surgeons throughout the world and replaced by the use of radium and subsequent wider irradiation with X-rays. This change was largely due to the influence of pioneer work done at the Curie Institute in Paris and Radiumhemmet of Stockholm. In fact, no sooner was the radium placed underground in September than gynæcologists implored that some of it should be made immediately available to save life and relieve distress.

In the case of cancer of the breast, both surgery and radiation are available, and it is a matter of expert advice to decide which is the better in a given case; always insisting on the importance of early and *correct* diagnosis. In carcinoma of the throat, treatment by the radium beam can be used without mutilation or loss of speech, and in cases too advanced for surgery While surgery may be of some avail with cancer of the rectum and prostate, we have to admit with regret that all methods fail when the œsophagus or stomach is concerned. In less serious cases—such as skin and lip cancer—either surgery or radiation is effective, but most patients would prefer to avoid mutilation and scar by the simple and perfectly safe application of a few milligrams of radium, or its equivalent, for a few hours.

It is scarcely necessary to reply to Sir Leonard Hill's reference to those unfortunate girls, who licking radium paint from their brushes, accumulated radium in their system. Is it suggested that this is in the remotest degree connected with radium therapy? As to the miners' phthisis in the Joachimthal mines, it can unfortunately be matched with closely similar results in the gold mines of South Africa—a matter requiring the closest attention and medical research with a view to prevention and cure.

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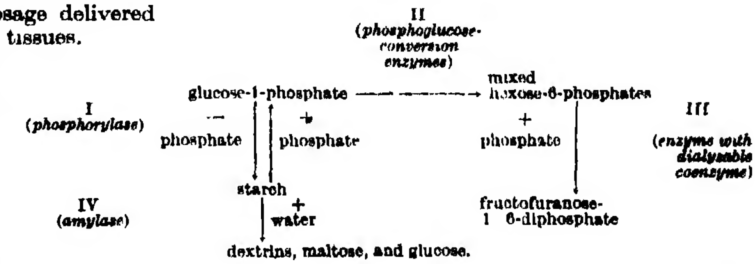
Feb. 5.

Enzymic Synthesis of Starch from Glucose-1-Phosphate

IN an earlier investigation[1] it was shown that pea seeds contain a complex of enzymes which catalyse the following series of reactions, I–IV:



These transformations exhibit a striking parallelism with those associated with the breakdown of glycogen, and its recently reported synthesis from glucose-1-phosphate (Cori-ester), under the action of the enzymes of yeast[2], muscle[3] and liver[4].

In order to study in isolation the reversible reaction I it was necessary to obtain the phosphorylase free from the enzymes which catalyse the alternative reactions II and IV. This was achieved with extracts from pea meal by a process of fractional precipitation with ammonium sulphate

Meanwhile it has been found that many plants contain phosphorylase, which is present in various organs including leaves, roots and tubers. The potato tuber has proved to be a particularly suitable source. Crude juice pressed from this tissue contains an active phosphorylase but exhibits no phosphoglucose-conversion activity; the weak amylase which is present is completely eliminated, and the phosphorylase is purified, by repeated fractional precipitation with ammonium sulphate.

Using these purified preparations of potato phosphorylase, a detailed study has been made of the reaction:

$$\text{Starch} + \textit{free}\text{-phosphate} \underset{b}{\overset{a}{\rightleftharpoons}} \text{glucose-1-phosphate.}$$

A state of equilibrium is reached, whether the reaction is proceeding in directions *a* or *b*, when the ratio of *free*-phosphate to glucose-1-phosphate attains a value which varies with the concentration of hydrogen ions. Thus in the equilibrium state at pH 6·4, 83 per cent of the phosphate exists as free-phosphate and 17 per cent as glucose-1-phosphate, whereas at pH 5·4 the proportions are about 90 per cent and 10 per cent respectively.

The equilibrium is not measurably affected by additions of starch even in considerable amounts, suggesting that the *effective* concentration of this reactant is not proportional to its *gross* concentration.

The presence of added starch, however, has a striking effect upon the velocity of the reaction proceeding in direction *b*. Without added starch there is a pronounced induction phase (in both the synthesis of starch and the liberation of *free*-phosphate). The initial velocity is increased by as much as 15-fold, and the induction phase completely abolished, by small additions of starch. This was the case in digests 1 and 2 (shown in Fig. 1), to which 2 mgm. soluble starch per 10 ml. was added initially. Other substances have been found to exert a similar activating effect upon the reaction, maltose being

an example which has been investigated in detail. This phenomenon, which promises to illuminate the mechanism of the catalysis, will be considered fully elsewhere.

Several specimens of synthetic starch, about 20 gm. in all, have now been prepared from glucose-1-phosphate (purified by recrystallization of the potassium salt). The yields of polysaccharide corresponded closely in all cases with those calculated from the amounts of phosphate liberated, and amounted under appropriate conditions to twenty times the weight of dry matter in the enzyme. The principal difficulty in the purification of the synthetic starch has been the removal of protein; thus the precipitates formed on adding trichloroacetic acid or lead acetate contained the bulk of the starch; conversely, the blue-black flocculum formed by the addition of iodine contained much of the protein of the enzyme solution. The reason for this became clear when it was found by microscopic examination that, in advanced stages of the reaction when a marked turbulence develops, the starch is present in the form of small rounded granules which appear to be surrounded by loose floccules of protein, the starch grains are clearly visible whether or not they are stained with iodine (Fig. 2). Under the conditions so far used they attained a maximum diameter of 6–8 μ.

Various observations indicate that the synthetic polysaccharide is closely similar to natural starch. The main discernible difference lies in physical properties, the synthetic material being more resistant to solution and tending to retrograde more rapidly than natural starch of the common relatively large-grained varieties. The following are some of the analytical observations made on purified specimens:

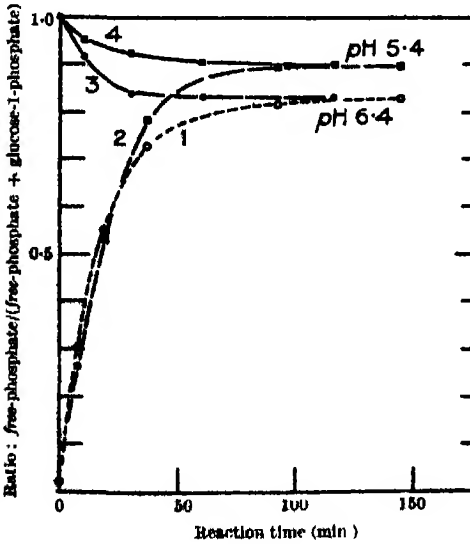
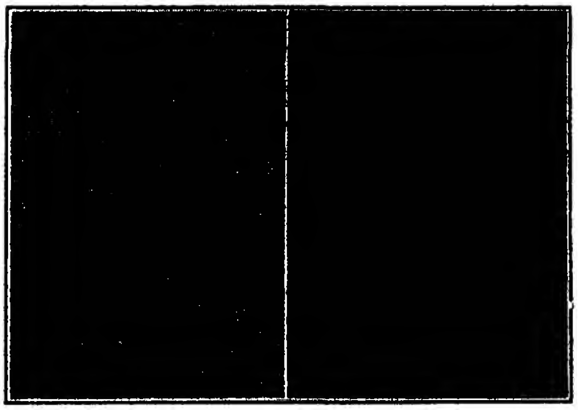


Fig. 1.

Curves 1 and 2 show the progress of the reaction: glucose-1-phosphate → *free*-phosphate + starch, catalysed by purified potato phosphorylase; final pH values, 6·4 and 5·4, respectively. Curves 3 and 4, at the same respective pH values, show the reverse reaction. In digests 1 and 2, approximately, M/100 glucose-1-phosphate was added initially to the enzyme, whereas in digests 3 and 4 starch with M/100 inorganic phosphate was added.



a *b*

Fig. 2

Photographs showing the grain structure of the synthetic starch. *a*, unstained; *b*, with dilute iodine. (× 290.)

Rotation—$[\alpha]^{20}_{D}$ + 200–206° (in water); + 152–159° (in 5 per cent soda); *Reducing power* (by copper reagent)—before hydrolysis, less than 1 per cent the reducing power of glucose; after 2·5 hours in *N*. hydrochloric acid at 100°—equivalent to 99 per cent conversion into glucose; nitrogen—0·05–0·5 per cent; phosphorus—0·05 per cent. In solution it gives a blue colour with iodine with the formation of typical iodine-starch floccules. The iodine-colouring property is rapidly destroyed by the action of the α-malt or salivary amylases.

The full discussion of the above interconversion, in which glucosidic linkages are formed and cleaved with the elimination and addition, respectively, of phosphate will be undertaken elsewhere.

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[1] Hanes, *Proc. Roy. Soc.*, B (in the press).
[2] Schäffner and Specht, *Naturwiss.*, **26**, 494 (1939); Kiessling, *Naturwiss.*, **27**, 129 (1939).
[3] Cori, Schmidt and Cori, *Science*, **89**, 464 (1939).
[4] Cori, Cori and Schmidt, *J. Biol. Chem.*, **129**, 629 (1939); Ostern, Herbert and Holmes, *Biochem. J.*, **33**, 1858 (1939).

The Nerve of the Pineal Gland

A bundle of nerve-fibres running upwards from the tip of the pineal gland in some mammals was described by Kolmer and Loewy in 1922[1], and was termed by them the "nervus conarii". However, the existence of this nerve as a constant feature has not hitherto been generally recognized, and its origin and destination remain obscure. It has been described by Pastori[2] as having a terminal relation to the wall of the great vein of Galen (vena magna cerebri). Recently the nerve has been identified and studied in this laboratory in monkey and human material. In both cases it has been traced, in cleared preparations and in serial sections, following an uninterrupted course from the pineal gland along the vein

of Galen to enter the dural wall of the straight venous sinus, where it runs in a subendothelial position.

In the human brain, the nerve passes through a remarkable formation of the arachnoid membrane. This resembles in some degree a greatly enlarged arachnoid granulation (Pacchionian body), measuring, in one specimen, 4·0 mm. in height and 2·5 mm. in width at its base. It projects up from the surface of the adjacent part of the cerebellum into the floor of the straight sinus at the point where this is joined by the vein of Galen, and is here attached to the dura mater. The structure of the granulation is peculiar in that it is filled with a sinusoidal plexus of blood-vessels and several large inter-connecting blood-sinuses. The pial matrix is unusually dense, and the general appearance bears a close resemblance to erectile tissue. The real nature and function of this arachnoid formation are still uncertain, but its structure and disposition suggest strongly that it may play an important part in regulating the venous return from the ventricles of the forebrain through the vein of Galen. In a distended condition, the granulation would bulge up conspicuously into the floor of the straight sinus at its anterior end, in a manner which must presumably impede the venous flow.

The nervus conarii, in traversing the granulation, actually passes through the cavity of one of the blood sinuses, ensheathed here in a fine covering of pial tissue. It then runs directly from the summit of the granulation into the dura mater and, as already noted, turns backwards in the floor of the straight sinus. Its further course has not yet been followed. The direction of conduction in the nerve is not known; the fact that in the monkey it can be traced to a core of neuropil in the centre of the pineal gland, in which are embedded numerous large ganglion cells of an autonomic type, suggests that it may be efferent with regard to the gland On the other hand, most authorities are now agreed that true nerve cells are not a normal constituent of the human pineal gland. The nerve is accompanied by a small arteriole, but this vessel is considerably smaller than the nerve itself. Finally, it may be noted that neither the monkey nor the human material has provided confirmation for the existence of a ganglion at the tip of the pineal gland, as described by Pastori.

A detailed report of these observations will shortly be published.

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Feb 11

[1] Kolmer, W., and Loewy, R., *Pflügers Arch.*, 196, 1 (1922).
[2] Pastori, G., *Zeitschr d ges. Neur u Psych*, 117, 202 (1928).

Cannabidiol and Cannabol, Constituents of *Cannabis indica* Resin

IN a previous publication, Work, Bergel and Todd[1] described a method for the separation of cannabinol from *Cannabis indica* resin (hashish) of Indian origin as its crystalline *p*-nitrobenzoate. In the course of further work on hashish we have been able, through the co-operation of the Home Office (Drugs Branch), to examine a fresh specimen of the Egyptian drug. Application of the *p*-nitrobenzoylation process to the distilled resin from this material yielded a less soluble fraction consisting of cannabinol *p*-nitrobenzoate (in smaller amount than from the Indian drug) mixed with a second ester of much lower melting point. The latter was very difficult to separate and purify; the free phenol obtained from it by hydrolysis was a yellowish resin which, in contradistinction to cannabinol, gave a positive Beam* test (purple colour with alcoholic potassium hydroxide).

Adams, Hunt, and Clark[2] have recently described the isolation from American hemp resin of a substance, cannabidiol, yielding a *bis*-3 : 5-dinitrobenzoate, m.p 106–107° ($[\alpha]_D^{27°} = -76°$). The similarity in colour reactions of cannabidiol and the above substance from the Egyptian resin was immediately evident, and conversion of the latter to its *bis*-3 : 5-dinitrobenzoate gave an ester m.p. 106–107° of which the analysis and optical rotation ($[\alpha]_D^{13°} = -76 \cdot 2°$) also agreed with those of the cannabidiol derivative; there can be little doubt as to the identity of the two compounds. The molecular formulæ of cannabinol $C_{21}H_{26}O_2$ and cannabidiol $C_{21}H_{30-32}O_2$, together with their simultaneous occurrence in hemp resin, suggest a structural relationship between the two compounds, and preliminary chemical investigation seems to bear this out[2]. It would seem that, as regards these constituents, Egyptian hemp resin occupies a position intermediate between American resin, in which cannabinol seems absent, and Indian resin, from which cannabidiol has not yet been isolated, although it may be present in small amount.

The physiological inactivity of cannabidiol lends further colour to the view that the Beam test is not a specific test for the active principle in hashish. We have noticed for some time that our most active fractions (Gayer test[3]) from the Indian drug give no coloration with alkali.

From certain fractions of Indian hashish we have recently, by acylation with azobenzene-4-carboxylic acid chloride, obtained a crystalline ester, m.p. 117–118° (Found: C, 78·0; H, 7·5; N, 6·1. $C_{21}H_{31}O.OCOC_{12}H_9N_2$ requires C, 77·9; H, 7·6; N, 5·4), apparently derived from a monohydric phenol. Alkaline hydrolysis of this ester gives a resinous phenol which reacts negative in the Beam test and gives, like cannabinol and cannabidiol, a positive indophenol reaction. The constitution of this new substance, which we name *cannabol*, remains to be elucidated, but it seems probable that it is a partially hydrogenated cannabinol isomeric with cannabidiol. This would accord with a possible view of the biogenesis of these substances. Cannabidiol may arise by condensation of a terpene with a dihydric phenol; cyclization would then yield cannabol, from which cannabinol could be obtained by dehydrogenation.

Further details of this work will be published elsewhere

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Feb. 6.

[1] *Biochem. J.*, [illegible], 123 (1939).
[2] *J. Amer. Chem Soc.*, [illegible], 196 (1940).
[3] *Arch. Exp. Path. Pharm.*, [illegible], 312 ([illegible]).

Polyploidy in *Rumex acetosella* L.

THE species *Rumex acetosella* L. is a weed, which seems to be distributed all over the northern hemisphere. It has been investigated cytologically by Roth[1], who counted the chromosome number $n = 16$ ($2n = 32$), and later, among others, by Meurman[2], Kihara[3], and Jensen[4], who all found the number to be hexaploid or $2n = 42$.

Last summer I examined material of *Rumex acetosella* and its varieties from Sweden and Iceland. In the main species, having rather broad leaves, I also found the hexaploid number $2n = 42$, both in the male and the female individuals. However, in plants belonging to the variety *tenuifolius* A and Gr. (Ascherson and Graebner[5]), the number proved to be $2n = 28$, or tetraploid. This number was not known before in *Rumex acetosella*, according to Tischler[6].

The leaves of the tetraploids are narrower than those of the hexaploid forms. In other details the tetraploid variety is also smaller than the main type, and most often shows a prostrate mode of growth. Both the tetraploids and hexaploids are quite normal sexually, and they also seem to have different geographical distribution.

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Feb. 14.

[1] Roth, F., *Verh d nat-hist Vereins d preuss Rheinl u Westf*, 63 (1906)
[2] Meurman, O, *Sci Soc Fenn* (Biol), 1 (1925).
[3] Kihara, H., *Bot Mag Tokyo*, 39, 353-360 (1925), *Jahrb wiss Bot*, 66, 442-460 (1927), *Jap J Genet*, 4, 90-101 (1929)
[4] Jensen, H, *Cytologia*, 7, 23-34 (1936)
[5] Ascherson, P, and Graebner, P, "Synops. d Mitteleur. Flor.", 4 (1908-13)
[6] Tischler, *Tabulae Biologicae*, 4 (1926), 7 (1931), 11-12 (1935), 16 (1938).

Occurrence of Bismuthinite in Somerset

AT the end of July last year, while examining the material on the waste-heaps of the Langham Hill Mine, one of the group on the Brendon Hills, Somerset, which was worked for iron during the middle and latter half of last century, I noticed small stains and patches of malachite on some of the crystalline chalybite at one end of the main dump. A number of these pieces were collected and, on being broken open, were found to contain small amounts of chalcopyrite, bornite, and occasionally chalcocite, while a few had, in addition, thin veins and patches of a steel-grey metallic mineral scattered through them, in some cases closely intergrown with the copper minerals.

Blowpipe tests on this steel-grey material showed the presence of copper and bismuth, and from its association with the other copper compounds, it was at first taken as possibly being tetrahedrite; recent chemical and X-ray examination, however, by Mr. F. A Bannister, of the Mineral Department of the British Museum (Natural History), has proved it to be bismuthinite (Bi_2S_3).

The presence of small amounts of copper minerals at one or two of these mines has been previously noted and mentioned, but there is no record of bismuthinite being found on the Brendons before, and it is a somewhat unexpected mineral to come across in this particular district, or, in fact, in Somerset as a whole.

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Points from Foregoing Letters

S. RUSS comments on recent statements by Sir Leonard Hill on the present-day position of radium treatment. He affirms it is not true that this form of treatment is largely carried on because of the vested interests of medical men; the reason for 15,000 patients having been treated in 1938 is that it was considered by responsible medical opinion to be the best treatment available for them.

A. S Eve also discusses Sir Leonard Hill's communication. He states that in cases of cancer of the uterus radium is frequently preferred to surgery. Inoperable cases of cancer of the throat are improved by radium beam treatment. The relative merits of radium and X-rays require further investigation, and the same is true of X-rays of various wave-lengths. Great Britain requires a radiological institute for the development and investigation of radiation treatment. In the meantime surgery, radium, X-rays all have their spheres of usefulness which overlap one another.

C. S. Hanes reports the occurrence in various higher plants of an enzyme which catalyses the reversible conversion of starch into glucose-1-phosphate. The effect of different factors upon the equilibrium is discussed, together with observations on the properties of specimens of starch synthesized from pure glucose-1-phosphate by the action of this enzyme. A fact of considerable botanical interest is that the synthetic starch is deposited in the form of well-formed grains.

W. E. Le Gros Clark states that the nerve of the pineal gland (nervus conarii) has been identified in human and monkey material. It runs an uninterrupted course from the tip of the pineal gland into the dura mater of the tentorium cerebelli, and then extends backwards in the floor of the straight venous sinus. On its way the nerve traverses a large arachnoid granulation the structure of which is peculiar in that it contains a plexus of sinusoidal blood-vessels. From the position of this granulation it is surmised that it may play an important part in regulating the venous return from the brain through the great vein of Galen.

The isolation of cannabidiol from Egyptian hashish is reported by A. Jacob and A. R. Todd, who find that in respect of its content of this substance and cannabinol the Egyptian drug is intermediate between the American and Indian varieties. A new compound *cannabol*, which is probably a partially hydrogenated cannabinol, has been obtained from Indian hashish.

RESEARCH ITEMS

Bronzes from Southern Nigeria

A REMARKABLE collection of bronze castings found at Igbo, Southern Nigeria, is figured and described by J. O. Field, assistant district officer, in *Man* of January 1940. They were unearthed in the course of digging a well, but no details are available. The castings would seem to have been made by the *cire perdue* process, though rubber latex may have been used instead of wax. The castings are covered with a rich green patina. The finest piece is an urn or cauldron 10½ inches high with a diameter across the top of 8 inches It forms a shallow bowl with broad lip on a wide hollow stand. It is decorated with a series of rosettes interspaced with beetles and grasshoppers. At top and base are bands of hatched triangles and in the middle a broad band with a complicated design of rectilinear figures and circles. The edge of the lip and the base are decorated with a twisted cord design. Among other objects are two scabbards in which are the remains of iron blades, but without hilts, a bust with evidence of bead ornament, small shells which rotate, a human head, possibly female, showing cicatrization resembling the modern style, two highly conventionalized rams' heads, with highly ornate twisted horns and three spiral objects, of which two display a snake *motif*, while another peculiar object is a massive casting elaborately ornamented with eyelets, loops and whorls, and also extensively ornamented with coloured beads, and near the top a series of rings from which emerge small snakes' heads, having above them a wheel-like flange with a great number of triangular spokes and on top of this a wide metal ring The occurrence of an 'Aro knot' suggests contact with the Aro people, but the earliest tradition of their presence in the region does not go back beyond about the middle of the last century. Otherwise there is nothing to determine the origin of this metal work. The Igbo people are not themselves metal workers, and it is improbable that they were made by Benin craftsmen.

Canoe-making in Ancient Hawaii

A TREATISE on the canoe-making profession of ancient times, of native authorship but undated, found among the archives of the Bernice P. Bishop Museum, Honolulu, has been translated and edited by Kenneth P Emory and Mary Pukui (*Occasional Papers, Bernice P. Bishop Mus*, 15; 1939). The writer opens with the statement that the profession was much practised in Hawaii to provide the canoes for fishing, for war and for voyaging from island to island, the experts who built them being much honoured and favourites of the chiefs. There were classes of experts under the classes of royal builders, such as the experts of the supreme ruler, of the ruling chiefs, of the district chiefs, and so forth. Of the timbers used, the koa (*Acacia koa*) was the best. All the forests were occupied by experts for making canoes. The adzes used were of stone. Their making was a laborious task, in which the various operations, chipping, grinding, lashing, were each done by different specialists. Different adzes were used for the various operations—chopping, hewing, hollowing. The canoe-makers were supplied with ancestral gods, who helped in the hewing and hauling. They were both male and female. The canoe-makers were also provided with offerings. If the canoe belonged to a chief these offerings were a hog, red fish, clothing, coconuts and awa. The hog was cooked at the place where the koa tree was to be found. The ancestral gods partook after an invocation, and then all the priests present partook of their portion. The cutting of the tree then began, the priests cutting in pairs. A little bird signified whether the tree would be good or the reverse. The canoe of a chief was hauled to the shore by the people after a feast. Felling the path of the canoe was the last thing to be done. If a new canoe was first taken on a fishing trip, the first fish caught was brought back and offered to the ancestral gods.

Birds of Newfoundland and Colour Modification

SURPRISINGLY little is known of the birds of eastern Newfoundland, and accordingly brief explorations made by David C. Nutt while a member of the Robert A. Bartlett Greenland Expeditions of 1937, 1938 and 1939, have added considerably to the knowledge of distribution, abundance and geographic variation. The results, by John W. Aldrich and David C. Nutt, have recently been published (*Sci. Pub. Cleveland Museum Nat. Hist.*, 4, 13; 1939) From a general point of view, the most striking result is the discovery that where geographic variation has taken place among resident birds it is shown in a marked darkening of the plumage This was found, for example, in birds so different as a creeper, *Certhia familiaris*, robin, *Turdus migratorius nigrideus*, "the most deeply coloured of all the American robins", warbler, *Dendroica breviunguis*, water-thrush, *Seiurus n. noveboracensis*, crossbill, *Loxia l. leucoptera*, and others. A similar darkness of plumage was noted in 1919 by G. K. Noble in birds from the western part of the island, but in the east the deepening of colour is even more marked, and confirms Noble's opinion that Newfoundland is a region where the differentiation of dark coloured races is beginning to take place It may be associated, as is probably also the case in the outer islands of Scotland, with the exceptional humidity of the region.

Transpiration into a Saturated Atmosphere

H. H. Dixon and J. S. Barlee have recently published a paper describing further experiments on transpiration into a saturated atmosphere (*Sci. Proc. Roy. Dub. Soc.*, 22, No. 20, 211; Feb. 1940). A potometer method for comparing the rates of transpiration in gases supersaturated with water is described, and it is shown that replacement of air with nitrogen around the leaves depresses and ultimately inhibits the upward movement of water in a stem. Renewal of the air restores transpiration. Anaesthetization with chloroform reduces or stops the movement; and at least temporary recovery may be attained by surrounding the leaves with supersaturated air. If the supply of supersaturated nitrogen or chloroform is prolonged, reversal of the upward current is produced, and the shoot behaves like a dead system and the water condensing on the leaves flows downwards in the stem.

Inheritance of Inability to Sweat

L. C. Glass and Darrell H. Yost (*J. Hered.*, 30, 477–478; 1940) report the inheritance of the inability to sweat. The affected individuals show distress at above 85° F., are subject to severe headaches and stomach trouble. The pedigrees suggest that the character is either inherited as a monogenic recessive or on a multiple factor basis. Not only is there an absence of sweat glands in the skin, but also other anomalies of skin development are present.

Sweet Potato Breeding

THE sweet potato rarely flowers or sets seed under field conditions in Louisiana. J. C. Miller (*J. Hered.*, 30, 485–492; 1940) reports useful methods for the induction of flowers and seed under these conditions. By staking the plants, three varieties were induced to flower, while girdling trebled the number of flowers and also induced earlier flowering. Seed setting was considerably increased by keeping a flowering branch in a water solution of artificial fertilizers in a house

Cytological Investigations in Allium

S. W. MENSINKAI reports on the chromosomes of seventeen species of Allium, fifteen of which had not been previously reported *A. sativum*, and *A. Cepa* ($2n = 16$) are taken to be secondarily balanced diploids since they possess two pairs of nucleolar chromosomes and two pairs of nucleoli. Univalents were observed at meiosis in *A. Cepa*, *A. Sewerzowii*, *A nigrum*, *A. scorzoneræfolium* (all diploids) and *A Bidwelliæ* (tetraploid). The individuals examined of *A. Cepa*, *A. Sewerzowii*, *A. cilicum*, *A. scorzoneræfolium*, *A. nigrum* and *A. Bidwelliæ* were inversion heterozygotes.

Wound Hormones of Plants

MANY plant tissue extracts are capable of inducing renewed growth activity in mature plant cells. These growth-inducing extracts are usually obtained from ground or heated tissues and are capable of evoking cell division and cell enlargement in unwounded cells. The active principles have been referred to as wound hormones by Haberlandt. J. English, J. Bonner and A. J. Haagen-Smit (*J. Amer. Chem. Soc.*, 61, 3434; 1939) find that the crystalline substance isolated from string bean pods and capable of inducing renewed cell division and cell extension activity in the parenchymatous cells of the bean pod is 1-decene-1,10-dicarboxylic acid (which they propose to call 'traumatic acid'), which was also synthesized. This is capable of inducing wound periderm formation in washed disks of potato tuber and to function thus as a wound hormone. Traumatic acid is also capable of partially replacing the juice of the tomato fruit in reversibly inhibiting the germination of tomato seeds.

Synthesis of Vitamin K_1

L. F. FIESER (*J. Amer. Chem. Soc.*, 61, 3467; 1939) has found that synthetic 2-methyl-3-phytyl-1,4-naphthoquinone is identical with natural vitamin K_1 by a direct comparison of samples with regard to analysis, spectrum, anti-hæmorrhagic activity, colour reaction, and the melting point and mixed melting point of a crystalline derivative. This confirms the conclusion reached by Doisy and co-workers from degradative experiments (*ibid.*, 61, 2558; 1939) and from a further synthesis (*J. Biol. Chem.*, 130, 432; 1939), published after the present work was completed. The synthesis was essentially a one-step process utilizing 2-methyl-1,4-naphthohydroquinone and phytol, and provides a method of preparing the vitamin in quantity. By separating and purifying the product in the reduced form prior to oxidation, the quinone is obtained in a pure condition without recourse to distillation or adsorption. Natural vitamin K_1 can be isolated very easily from alfalfa concentrates by a similar procedure Vitamin K_1 yields phthiocol on cleavage with alcoholic alkali.

Oxidation with Lead Tetra-acetate

IT is known that the cleavage of the carbon chain in compounds containing two and three adjacent hydroxyl groups can be carried out with lead tetra-acetate in aqueous as well as in non-aqueous solution. J. M. Grosheintz (*J. Amer. Chem. Soc.*, 61, 3379, 1939) finds that the cleavage of the carbon chain of a number of glycosides with lead tetra-acetate is parallel to that known to be produced with periodic acid The oxidative changes of alpha- and beta-methyl-*l*-arabinopyranosides can be carried out quantitatively in aqueous solution. Contrary to previous experience, three molecules of lead tetra-acetate instead of two were required to complete this reaction, and the reason was found to be the oxidation to carbon dioxide of one molecule of formic acid formed during the first reaction. This reaction does not occur in dry organic solvents or in oxidation in aqueous solution by means of periodic acid, and the formic acid may be oxidized in its ortho-form.

Photometry of the Solar *D* Lines

ALTHOUGH the *D* lines have been measured several times previously, there has always been some doubt about the instrumental corrections, more especially for the central intensity. In a recent paper (*Mon. Not. Roy. Astro. Soc.*, 100, 1; November 1939), C. W. Allen gives the results of his measurements, corrections derived from a comparison with terrestrial water-vapour lines having been used. The sun telescope and three-prism spectrograph of the Commonwealth Solar Observatory were utilized for the solar spectra of the *D* region. Plates were taken of both centre and limb of the sun near midday, and others were exposed for a few minutes after sunrise to ensure strong water-vapour lines. The results for the central intensities and equivalent breadths are in good agreement with his observations made some five years ago, but the central intensities are much smaller than Houtgast's results published in 1938. The discrepancies are due to the fact that Houtgast made no corrections for finite resolving power.

An Altazimuth Mounting for Reflecting Telescopes

THE REV. W. REES WRIGHT has described a useful wooden mounting to carry a 9-inch reflector which he has manufactured himself (*J. Brit. Astro. Assoc.*, 50, 3; 1940). The base of the stand is merely a stout three-legged stool, each leg being 30 in. long and 3 in. by 2 in. in section. The top consists of two thicknesses of 1-in. wood, screwed together with the grain crossing, and twelve ball-casters are screwed to the upper piece so as to form a circular bearing for the head. It is possible to raise or lower these casters slightly to make certain that all bear on the head in all positions. Many other details are given which can be easily followed by amateurs, who are recommended to study the description with the diagram if they require a cheap and efficient mounting for a small reflector.

FLORAL ANATOMY OF THE OLEACEÆ

By Prof. A. C. Joshi and A. N. Fotidar,
Benares Hindu University

A STUDY of the floral anatomy of the Oleaceæ, including *Jasminum pubescens*, *J. Sambac*, *J. auriculatum*, *J. arborescens*, *J. grandiflorum*, *J. humile*, *Nyctanthes arbortristis*, *Olea cuspidata*, *O. fragrans*, *Syringa vulgaris*, *S. emodi* and Ligustrum spp., has brought to light many interesting facts, particularly with regard to the anatomy of the pedicel in Jasminum species and the vascular supply of the ovule. As the full work will take still some time to be completed, the more important observations made so far are recorded here.

The pedicel has normal structure in Olea, Syringa and Ligustrum. Even in *Nyctanthes arbortristis*, where the vegetative stem is characterized by the presence of four inversely orientated cortical bundles[1], the cortical bundles gradually disappear in the floral axis and it has a normal structure. In Jasminum species, however, the condition is very different. In *J. auriculatum*, *J. humile* and *J. arborescens*, the pedicel has normal structure, but in others the pedicel shows, besides the normal vascular ring, many additional bundles in the pith, even though the structure of the vegetative stem is quite normal. Thus in *J. pubescens*, we find that the pedicel just at its base shows only one ring of vascular bundles, but as we proceed upwards, two or three bundles of phloem make their appearance in the pith. Higher up, the number of such bundles increases and they develop both xylem and phloem, so that a transverse section of the pedicel shows many medullary bundles irregularly scattered inside the normal ring (Fig. 1). The structure of these bundles is very variable. They may be collateral, normally or inversely orientated, bicollateral, concentric with phloem in the centre, or may consist of phloem alone. As the calyx-traces begin to pass out, we often find the medullary bundles to show a more regular arrangement. They tend to form a ring of mostly inversely orientated collateral bundles to the inside of the normal ring (Fig. 2). This condition resembles to a certain extent the structure of the stem in certain species of Rumex belonging to the section Lapathum[2], or the structure of the stem of many Cucurbitaceæ[3] and other families possessing medullary phloem. At a still higher level in the thalamus of *Jasminum pubescens*, the medullary bundles gradually pass out and disappear, merging into the bundles of the normal ring. In a large-flowered variety, however, it was observed that all the medullary bundles ultimately fuse in the centre and give rise to a prominent concentric bundle in the centre of the thalamus stele (Fig. 3), which divides again into about four branches that fuse with the ventral traces of the carpels. The pedicel in *J. grandiflorum* shows structure very similar to that of *J. pubescens*, but the medullary bundles are still better

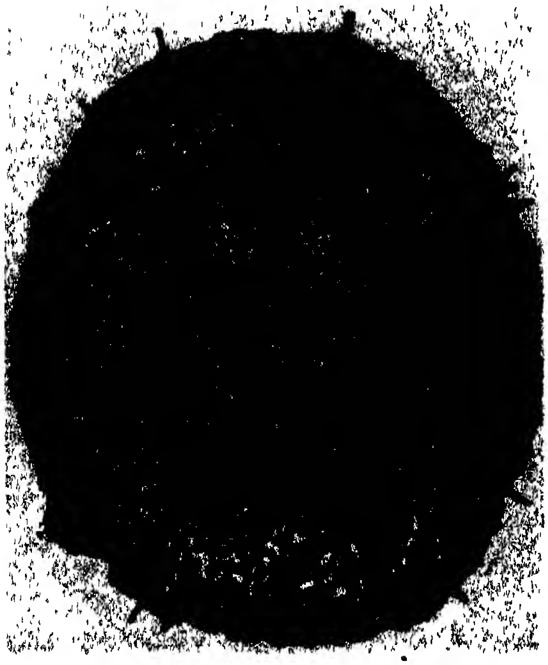

Fig. 1.

Jasminum pubescens TRANSVERSE SECTION OF THE PEDICEL SHOWING IRREGULARLY SCATTERED MEDULLARY BUNDLES.

Fig. 2.

Jasminum pubescens. TRANSVERSE SECTION OF THE THALAMUS ABOUT THE LEVEL OF THE ORIGIN OF THE CALYX-TRACES SHOWING A REGULAR RING OF MEDULLARY BUNDLES INSIDE THE NORMAL RING.

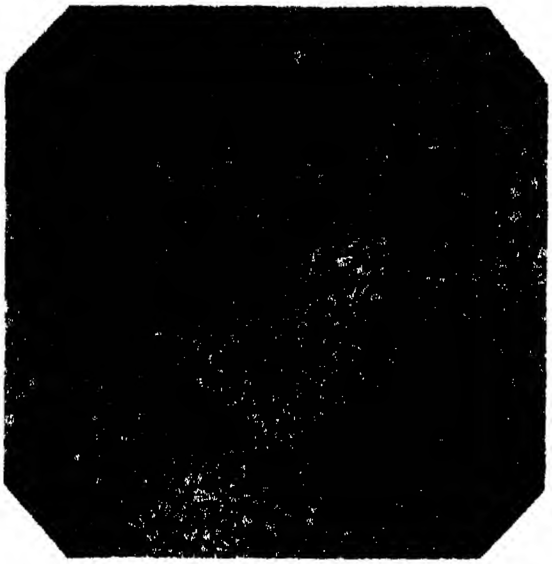

Fig 3

Jasminum pubescens, LARGE-FLOWERED VARIETY TRANSVERSE SECTION OF THE THALAMUS JUST BELOW THE OVARY SHOWING A CONCENTRIC MEDULLARY BUNDLE IN THE CENTRE OF THE NORMAL STELE

developed. The pedicel in *J. Sambac* also shows medullary bundles, but here their number is comparatively smaller and they consist mostly of phloem alone (Fig. 4). Their structure, however, is essentially concentric, the phloem being surrounded by a cambial ring which forms new phloem elements towards the inside and occasionally some xylem towards the outside.

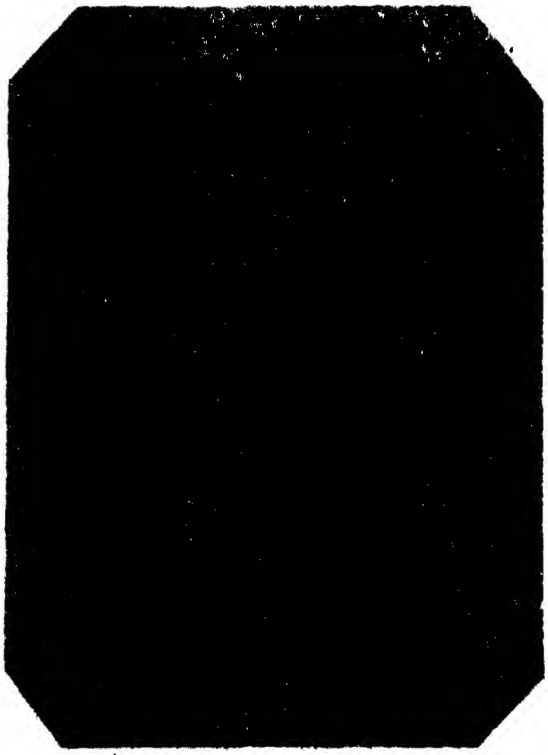

Fig. 4.

Jasminum Sambac. TRANSVERSE SECTION OF THE PEDICEL NEAR ITS DISTAL END SHOWING MEDULLARY BUNDLES OF PHLOEM SURROUNDED BY CAMBIUM.

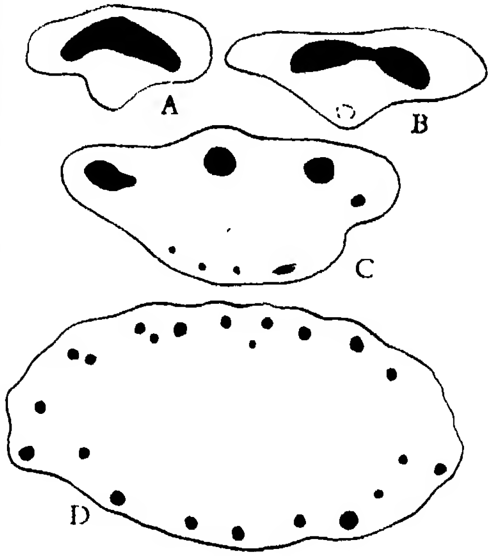

Fig. 5.

A–D Nyctanthes arbortristis. TRANSVERSE SECTIONS OF AN OVULE FROM THE FUNICLE (*A*) TOWARDS THE MIDDLE (*D*).

The ovules of Syringa, Olea and Ligustrum species possess normal vascular supply. They receive a single bundle which runs up the raphe unbranched and ends in the chalaza. But in Jasminum and

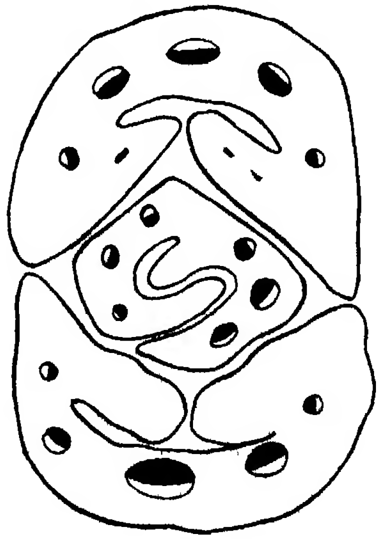

Fig. 6.

Olea fragrans. TRANSVERSE SECTION OF THE GYNŒCIUM SHOWING TWO DECUSSATE WHORLS OF OPEN CARPELS. THE OUTER CARPELS BEAR OVULES ALONG THEIR MARGIN. THE INNER CARPELS HAVE NOT YET COMPLETELY SEPARATED FROM ONE ANOTHER. AN OVULE IS SEEN ARISING FROM THE MARGIN OF ONE OF THEM.

Nyctanthes, the crescent-shaped ovular trace (Fig. 5*A*) soon after its entrance into the funicle divides into two bundles (Fig. 5 *B*). These bundles repeat the division and some of the branches pass to the opposite side (Fig. 5 *C*). These branches divide further, so that the ovule shows about its middle 25–30 bundles in the integument (Fig. 5 *D*). Such extensive development of the integumentary vascular system has been observed so far only in a few other flowering plants. These have been listed by Dahlgren[4]. From comparison with the gymnosperms, the presence of such an integumentary vascular system is generally regarded as a primitive character[5], but its occurrence in such gamopetalous forms as the Oleaceæ and the genus Echinops[4] of the Compositæ together with its absence from such a primitive order as the Magnoliales raises a doubt that this character may be really a recent acquisition related to the development of an exceptionally thick integument.

The perianth traces in the Oleaceæ are noteworthy for showing concentric structure, but specially interesting is the vascular supply of the calyx in *Olea fragrans*. In this species, although the calyx is quite well developed, in many flowers there are absolutely no traces for the four sepals. In other flowers, two or three weak sepal traces are given out, but these disappear in the thalamus itself and never reach the sepals. The calyx is thus quite non-vascular. This supports Mrs. Arber's[6] view that the vascular tissue is in no way more conservative than the organ it supplies.

The gynœcium of *Olea fragrans*, a cultivated garden shrub which does not set seed, consists of two whorls of opposite and decussate open carpels bearing ovules along their margins (Fig. 6). This abnormal structure of the gynœcium is the normal feature of this species in the material at our disposal.

[1] Fotidar, A. N., *J. Ind. Bot. Soc.*, 18 (1939).
[2] Joshi, A. C., *Amer. J. Bot.*, 23 (1936).
[3] Holroyd, H., *Bot. Gaz.*, 78 (1924).
[4] Dahlgren, K. V. O., *Svensk Bot. Tidsk.*, 18 (1924).
[5] Wettstein, R. v., "Handbuch der systematischen Botanik" (1935).
[6] Arber, A., *New Phytol.*, 32 (1933).

RURAL LIFE IN EUROPE

BY DR. L. DUDLEY STAMP

IT is one of the inevitable consequences of war that the steady march of social progress is interrupted by the more urgent problems of the moment. In Britain, for example, the great work of slum clearance and rehousing has been temporarily suspended, and it is actually possible in the lull to take stock of what has been achieved in the past twenty years. On the other hand, reforms which might have been delayed indefinitely may be rushed through if they have an important bearing on the prosecution of the War. The war-time ploughing programme of the Government may well be the salvation of British agriculture, and the evacuation to rural areas of both children and adults supplies just the stimulus which was needed to stem the tide of rural depopulation and the consequent disappearance of rural community life.

It is indeed certain that all the countries of Europe were becoming aware of the seriousness of the problems of rural life, and no fewer than twenty nations had agreed to take part in a European Conference on Rural Life—to be "devoted to the well-being and solidarity of the European peasantry"—under the auspices of the League of Nations at Geneva in October 1939. The Conference, a natural development of that on Rural Hygiene in 1931, was to have based its work on a series of documents previously prepared. The documents were of two main types: (*a*) illustrated national monographs, prepared officially according to a uniform plan, presenting in attractive style a résumé of the problems of rural life, and (*b*) studies on specific problems prepared by various international bodies.

Several of the national monographs were published[1]—including those for Belgium, Finland, Latvia, Lithuania and Netherlands—and form handy summaries covering the organization of rural life and occupations, including education, medico-social policy and nutrition.

Of the second group of pamphlets, the International Labour Office prepared one on recreation in rural areas and one on sickness and insurance; the International Institute of Intellectual Co-operation one on intellectual aspects of rural life, and the Health Committee of the League of Nations a general survey of medico-social policy. These surveys[2] suffer from the difficulty that they deal with political units so utterly different that comparisons are virtually impossible. The very word 'peasant' is rarely if ever applied to the English country dweller, and the problems here are obviously very different from those in eastern Europe. Nevertheless, it is remarkable that certain fundamental difficulties are apparent throughout—and outstanding is the inadequacy of rural housing. Cramped, overcrowded, ill-planned houses, frequently with antiquated sanitary arrangements, no piped water supply and lacking electric light not only affect health (for example, tuberculosis) but also prevent the proper use of leisure and opportunities for recreation and education which are otherwise available.

Rural housing is, after all, only one result of the fundamental economic position. A few years ago Lord Stamp[3] summed up the whole problem in a single sentence: "the world as a whole and over a given length of time has almost certainly been fed below cost-price for the last hundred years, if one takes into account the proper elements of costs". The more advanced nations are often the last to recognize that the rural countryside needs above everything money. Britain is certainly no exception; with the drift to the towns from the impoverished country areas Britain has become more and more urban-minded as well as urban-dwelling. The Town and Country Planning Acts only conceive 'planning' in terms of urban expansion, whilst slum-clearance is regarded as a problem of the great cities despite the fact that the worst slum is often the farm labourer's cottage.

[1] Allen and Unwin, 40 Museum Street, London, W.C.1. 1s. 6d. each.
[2] Allen and Unwin, 9d. and 1s. each.
[3] "World Agriculture: an International Survey", 1932.

PRACTICAL ASPECTS OF EARTHING

IN a paper contributed by Messrs. E. Fawssett, H. W. Grimmett, G. F. Shotter, and H. G. Taylor, to the Institution of Electrical Engineers on February 14, a very thorough discussion is given of the practical aspects of earthing.

The practice of earthing is as old as that of electrical engineering; in fact it is older, as it dates back to the days when electricity was only a scientific study which scarcely interested the engineer. Earthing was then effected by touching the charged body with the finger, whereupon the charge leaked to earth. From then the practice has passed through many phases, though customs die hard, as shown by the 1937 report of electrical accidents in factories and workshops, which states that "another instance was found where the end of the earthed wire was put into a bucket of water, the bucket being specially purchased for the purpose and usually placed on a piece of wood 'to avoid leakage' ".

At the other extreme, and typifying the very latest practice, may be cited the proposal to install eight 32 ft. × ½ in. diameter copper rods at a Central Electricity Board substation to secure a resistance of less than one ohm, in soil having a resistivity near the surface of 15,000 ohm-cm. Before 1914 such a resistance would not have been obtained in such soil; in more recent times it might have been obtained, but at a cost at least several times greater than is required to-day; it is now a relatively simple matter. Earthing practice is a good example of the well-known fact that until a quantity can be measured and expressed numerically knowledge is restricted and improvement is slow. For this reason great credit is due to those firms which have produced simple forms of earth-testers which can be used as readily as an insulation-tester. By their use engineers have realized in some measure the limitations of methods of earthing which had been used for many years, they have realized the important effect of the resistivity of the soil, and finally they have found by a few tests that some methods of earthing are far more economical than others.

American engineers profited by a comprehensive publication on earthing issued by the Bureau of Standards in 1918. The recommendations of this report, which are still quoted, were well in advance of British practice at the time, though much has been done to make up the leeway during the last few years. Driven electrodes are now being widely used, and in two important fields, namely, voltage gradients on the ground surface around electrodes and current loading capacity of electrodes, the principal progress has been made in Britain. Research by the Electrical Research Association (E.R.A.) has also shown how the earth resistance of overhead-line towers may be measured without disconnecting the earth wire—a problem in measurement the solution of which is actually of greater importance in other countries than in Great Britain.

All the information necessary to design electrodes economically on a resistance basis is now available and is being used to an appreciable extent. All the research work also that is necessary that has been done on the problem of voltage gradient is available, though it is not as widely known as it should be. The loading capacity problem is still under examination; sufficient information is available to provide a lead in all soils and to give a good guide in clay; when this problem has been completely solved, it will be possible to design electrodes for any condition with as much precision as that of the electric appliances which they protect.

For several years past the E.R.A. has been carrying out investigations into the fundamental problems connected with earthing, and a number of reports have been published. It is considered that the present time is an appropriate one to review the work that has been done, with particular reference to the practical problems of supply undertakings. All the four authors have been closely associated with the E.R.A. researches; most of the work is now published for the first time

It must be strongly emphasized that the value of the earth has an important bearing on the operation of high-voltage fuses and the protective gear installed. Earth leakage protection installed at the main points of an overhead ring main will ensure the safe operation of the switches by a high-resistance fault. If when the conductor falls the line is not cleared, such a fault may result in a serious accident.

Resistance earthing and so-called 'solid earthing' are general in Great Britain. Reactance earthing of the type practised in America is practically unknown, but tuned resistances (for example, Petersen coils) are now being installed to an appreciable extent. These coils are short-circuited occasionally, and consequently the earth resistance must be such as is required on an ordinary earth system

In rural areas where the villages are far apart, and where each village is as a rule fed from one substation, the question of low-voltage neutral interconnexion does not occur, and it is here that the difficulty of earthing arises. On urban low-voltage systems it is generally easy to secure low resistances to earth, but in rural areas where water mains are frequently not available for earthing, there are serious difficulties. If it is proposed to work according to the regulations with just one earth, it is necessary to have the substation earth resistance very low (something less than five ohms), and this is frequently very difficult to secure.

In practically all instances in Great Britain where overhead lines have latticed steel towers for supports, these lines carry a continuous earth wire, the function of this wire being to ensure that all extraneous metal work is at earth potential, to act as a release for fault current, and as a protection against lightning. It has now been generally accepted that to make a line secure against lightning it is essential that the continuous earthed wire should be earthed at each tower and that this resistance should be less than about ten ohms. The foundations alone of these towers sometimes have a sufficiently low resistance for other protective purposes.

The earth resistance at consumers' premises should be sufficiently low to blow the largest fuses, but from the economical point of view this is not always possible. This has led undertakings to consider protective multiple earthing, neutralizing or earth-leakage circuit-breakers. The ordinary 18-in. square earth plate or the 3-ft. earth rod is of very little use

in the majority of soils found in rural England. Ordinary earthing—that is, one system earth at the substation and the consumer's earth utilizing the public water mains or the cable sheaths—has proved quite satisfactory in urban areas and has been the general practice in Great Britain The main difficulty with ordinary earthing occurs when the system is overhead and is situated in a district without a piped water supply. The use of strip electrodes has been the means of reducing substation earth resistances to a reasonable figure and deeply driven rod electrodes have also proved useful.

The chief disadvantage of protective multiple earthing is the danger arising from a broken neutral conductor. To minimize the risk the earth resistance of the neutral is made as low as possible, and earths are provided at all consumers' premises. Where the soil resistivity is high (as would generally be the case) this represents a serious expense The money might be more advantageously expended in ensuring that in the event of only a neutral breaking it would make contact with a live wire and so blow the fuse and disconnect the supply from the faulty section

In order to determine the reduction of resistance effected by salting, and the frequency with which it is necessary to re-salt electrodes, tests have been in progress over a period of five years in five different sites where various extremes of soil conditions and rainfall exist. Tables are given showing the seasonal change of resistance of electrolytes and the effect of salt and coke treatment. Whilst salting reduces the resistance of earth electrodes it is generally recognized that it increases the rate of corrosion. The following conclusions are of practical importance. Failure of all electrodes in clay soil is caused by the attainment of a temperature of 100° C. at the electrode surface. At this temperature the moisture present evaporates, and the resistivity of the soil increases to a very high value. In clay soil with alternating currents, small leakage currents flowing for a long time do not impair the characteristics of an electrode, since they reduce its resistance. On the other hand, they seriously impair an electrode's characteristics if the electrode is connected to a positive lead. New work is now planned on the behaviour of different types of soil, the requirements of Petersen coil earth electrodes, and the behaviour of long electrodes and electrodes in parallel.

FIRE FIGHTING EQUIPMENT FOR ELECTRICAL INSTALLATION

LAST year the Electricity Commission requested the Electrical Research Association (E R.A.) to consider what steps should be taken to try to prevent a repetition of one or two disastrous fires that had taken place in connexion with electric power stations and electrical installation. The E R.A. appointed a committee to consider the whole matter and its report was discussed at the Institution of Electrical Engineers in London on January 25.

Mr. H. W. Swann, H.M. senior electrical inspector for the Home Office, presented the report and opened the discussion. Mr. Swann pointed out that when his committee first took the matter in hand there was a dearth of information available as to the performance of certain media used for fighting fires, and, hearing that a good deal of work had been done in Paris on this subject, the committee paid a visit there and obtained a great deal of information. But it was felt that something more should be done in Great Britain. Luckily, the co-operation was obtained of the County of London Electric Supply Co. at its power station at Barking, and also the help of the London Fire Brigade and the manufacturers of various proprietary media for dealing with fires.

Mr. McMahon introduced the report of the Committee and showed some colour films illustrating in a striking manner the starting and progress of the experimental fires and how they were extinguished. The length of the films taken amounted to 1¾ miles, about ten per cent of which were shown. The films were very instructive and many lessons were obtained from them. All the fires were artificially created and tests were carried out with methyl bromide gas, carbon dioxide, mechanical foam, chemical foam and water, as extinguishing media.

The recommendation made by the E.R.A. Fire Committee is that, for outdoor oil risks, the most suitable form of fixed installation is the atomized water type, or, if local conditions prevent this, then foam should be used Failing either of them, inert gas media should be used, although when other media are available gas is not recommended. For indoor oil risks, it is stated that where weatherproof metal-clad gear is installed, atomized water will provide adequate protection, subject to precautions being taken to ensure that any apparatus not of the weatherproof type is not liable to suffer serious water damage. Where there are no draughts, gas protection can be applied, and although protection can be obtained with foam, there is the disadvantage that it leaves deposits which may hinder repair operations. For cables in enclosed spaces not liable to draughts, inert gas protection is effective under conditions of rapid operation. Difficulties may be encountered with water and foam. Much the same remarks are applied to cable galleries exposed to the atmosphere, and where gas is not safely applicable then water or foam installations will afford adequate protection. Certain recommendations are also made with regard to portable apparatus, and it is also recommended that back-up protection by means of water hydrants should be provided in case of emergency.

Mr. Nimmo, one of the Electricity Commissioners, remarked that whilst an examination of the films showed that the risk from oil is obviously so great that some might think that the use of oil-less switchgear should be enforced, yet it has to be remembered that there is a great deal of oil gear in everyday use, and steps have to be taken to protect it. In his opinion, water properly applied is the best medium; with the other media used in these tests, experts had

applied them. The ordinary user is still left wondering which is the best to use. Usually it was applied by the station personnel. The cooling effect of water gives it a tremendous advantage over carbon dioxide, methyl bromide or carbon tetrachloride. Accepting this, he suggested that for outdoor and indoor transformers and oil and bitumen-filled switchgear, an automatic atomized water installation might be used, and for cable basements and cellars where oil is not likely to be present, ordinary sprinklers would suffice. Finally, he prefers a water pressure of 60 lb. per sq. in and a ten minutes storage supply to the 50 lb. and four or five minutes recommended in the report.

Mr. C. M. Kerr, who is an officer of the London Fire Brigade and was also a member of the Fire Committee concerned with these tests, spoke of the difficulty of laying down hard-and-fast rules for dealing with these fires and emphasized the need of ample back-up protection; to this, he thinks, too little attention has been given in the report. He also mentioned the need for attention being given to the maintenance of the various forms of fire fighting equipment as a consideration in determining their choice.

Mr. H. Bright said that although the title of the report was "Fire Fighting Equipment for Electrical Installations", it dealt, as did the discussion, solely with power stations. There are, however, installations, such as those in places of entertainment and elsewhere, where the risk of life from oil fires is very much greater than in power stations. In such cases, certain of the media mentioned must be ruled out because of their toxic or suffocating effects. In such places, too, it would be impossible to drain the oil from the transformers into pits, as was suggested for power stations. The alternative seemed to be to have a large tank.

Mr. Hacking, who replied to the discussion, said that the word 'emulsification' was deliberately not used in the report, because satisfactory results had been obtained using water, when there was no question of emulsification. He agreed that the smoke detector should only be used as a detector.

INSECT PESTS OF CROPS IN ENGLAND AND WALES

BY DR. A. D. IMMS, F.R.S.

BULLETIN No 118 of the Ministry of Agriculture and Fisheries, recently issued, records the incidence of the more important crop pests for the years 1935–37. The information upon which it is based has been supplied in the main by the advisory entomologists and other reporters. It appears that numerous foreign insects were intercepted by the Ministry's inspectors during their examination of imported plants and others were sent in by the general public. The great majority of these aliens were unlikely to prove either injurious or to establish themselves in Great Britain. A few, however, were of a different category and need brief reference.

The Colorado beetle (*Leptinotarsa decemlineata*) was represented by a few individuals found in the vicinity of London and Swansea. For the most part they were known to have been introduced through shipping, but no outbreak occurred during the period under review. The chrysanthemum midge (*Diarthronomyia* sp.) first occurred as an outbreak in 1927 but, by 1930, the pest was reported to have been eradicated. After an interval of six years a new infestation was discovered in southern England and appears to have had origin in plants or cuttings imported from the United States. In order to render the position more secure in future the importation of chrysanthemums has now been prohibited, except under special licence, which prescribes rigorous precautions to be observed.

The asparagus fly (*Platyparea pœciloptera*) had not been previously noted in England until it was discovered by C. Warburton in a garden in Hertfordshire in 1935. Subsequent work carried out by the Ministry's inspectors showed that it is too widely established in that county to render any attempt at eradication practicable. The species is a serious asparagus pest on the Continent of Europe and its presence in England may result in the shortening of the productive life of the beds, but it is probable that reasonable commercial control will be attained.

During the period under review, while many of the regular pests of English crops were prevalent, relatively few are specially noteworthy. Mention, however, must be made of the codling moth, which caused very serious damage in most fruit-growing districts during 1935 although it was much less troublesome in the two succeeding years. On the upland pastures of mid-Wales and parts of northern England, outbreaks of larvæ of the antler moth caused loss of sheep-keep. Wheat and oats were seriously attacked by the aphid *Myzus festucæ* in 1935, large acreages in many districts being almost completely ruined. As with the codling moth, the attacks were much less evident in the other two years.

Among unusual records larvæ of the sword grass moths (*Polia vestusta* and *exoleta*) attacking hops and of the holly blue butterfly (*Lycæna argiolus*) injuring raspberries are of interest.

The bulletin also gives a summary of progress as regards insecticides and their application, and concludes with a useful list of references to papers published in Great Britain, during the triennial period, which are concerned with crop pests and related subjects. Viewed as a whole the situation is very satisfactory. Possible danger from the introduction of the apple maggot from Canada and the United States and of the cherry fruit fly from various European countries has been reduced to small proportions by timely action being taken. Also the well-organized watch kept for the Colorado beetle has amply justified itself, since no outbreak has occurred; yet, on the Continent of Europe, its spread eastwards extends yearly and it now has an almost continuous range from southern France to central Germany.

SEVENTY YEARS AGO

NATURE, vol. 1, March 3, 1870

Natural Science at Cambridge

THE Rev. T. G. Bonney, the geologist, concluding an article on this subject, writes: "I may venture to express my conviction, that the coldness and even dislike with which the study of Natural Science was once regarded here is rapidly passing away, that the number of earnest students in the various branches is annually increasing, and that the University is fully alive to the wants of the age; so that, while she can never neglect or forget those old paths of Classics and Mathematics in which many of her sons have won an almost world-wide reputation, she will heartily welcome, and will regard with no less pride, all who are among the followers of sciences of a more recent date."

Measurement of Geological Time

ALFRED RUSSEL WALLACE presents the second and concluding article on this topic. He discusses, in particular, the effects of denudation as shown by Geikie's investigations. Surveying the estimates made by Tylor, Croll, Geikie and Lyell, he deduces a scale of geological time ranging from 24,000,000 years for the beginning of the Cambrian, to 2,000,000 years for the beginning of the Lower Miocene. He continues: "These figures will seem very small to some geologists who have been accustomed to speak of 'millions' as small matters; . . . Taking Sir William Thomson's allowance of a hundred million years for the time during which the earth can have been fit for life, it yet allows Mr. Darwin, for the process of development from the primordial germ, three times as many years anterior to the Cambrian epoch as have elapsed since that date, an amount of time which, I believe, will fully satisfy him, by whatever scale we may measure it."

Industrial Use of an Electric Motor

"FOR many years it has been a query whether the electric current might not be brought so far under man's control as to take the place of steam as a motor for machinery, and success has at last crowned the persevering efforts of scientists. At the last exhibition of the American Institute, there was seen an elliptic lock-stitch sewing machine, driven by a small electric engine which might easily be put into a common hat box. . . The use of this motor, if it becomes general, cannot fail to prove of the utmost benefit to ladies, especially to machine operators, as it does away entirely with the necessity for using the feet, as is now the case, and must be highly conducive to the health of females, who suffer from many diseases that are generated by the constant strain on the pedal and limb muscles. The inventor of the engine in question is Charles Gaume."

"MR. E. RAY LANKESTER has been elected by examination to the Radcliffe Travelling Fellowship at Oxford."

THE *American Gaslight Journal and Chemical Repertory* states that Professor Loomis, who claims to have discovered a way to transmit messages by electrical air currents without the aid of wires, wants to be appointed Consul to some European port, that he may experiment on the summit of Mont Blanc.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TWO TEACHERS OF ENGLISH in Timisoara and Iasi—The British Council, 3 Hanover Street, W 1 (quoting 'Rumania') (March 9).

TECHNICAL ASSISTANT in the Mechanical and Electrical Engineer's Section—The Engineer and Manager, Waterworks Department, Town Hall, Manchester 2 (March 16).

ONE SENIOR ASSISTANT and SIX ASSISTANTS for Evening Institutes in Egypt—The British Council, 3 Hanover Street, W.1 (quoting 'Egypt') (March 18)

DIVISIONAL ENGINEER (WIRELESS) for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9134).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry, Leaflet No. 7: Carbon Monoxide Pp iv+9+2 plates (London H.M Stationery Office.) 1s. 6d net [142

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences No 793, Vol 238: Stress Functions for a Plate containing Groups of Circular Holes By Dr. R C. J. Howland and Dr R C Knight Pp 357-392 6s. No. 794, Vol 238: Crystallographic Studies of Meteoric Iron. By J. Young. Pp 393-422 6s 6d No 795, Vol 238: The Asymptotic Expansion of Integral Functions defined by Taylor Series. By Prof. E. M Wright Pp. 423-452 4s (London Cambridge University Press) [142

University of London Institute of Archæology Geochronological Table No. 1: An Attempted Correlation of Quaternary Geology, Palæontology and Prehistory in Europe and China By Wen-Chung Pei (Occasional Paper No 2.) Pp. 16+2 tables. (London: University of London Institute of Archæology) 2s 6d [142

The Carnegie Trust for the Universities of Scotland. Thirty-eighth Annual Report (for the Year 1938-39) submitted by the Executive Committee to the Trustees on 12th February 1940. Pp. iv+90. (Edinburgh Carnegie Trust for the Universities of Scotland.) [142

Imperial Bureau of Plant Breeding and Genetics. Field Trials: their Lay-out and Statistical Analysis. By Dr. John Wishart Pp 36. (Cambridge. School of Agriculture) 2s 6d [142

Other Countries

Imperial Council of Agricultural Research, India. Scientific Monograph No 13 Further Observations on Anatomical Deviations in the Ox and Notes on Certain Anatomical Freaks. By H. N. Chelva Ayyangar. Pp. vi+42+31 plates. (Delhi: Manager of Publications.) 2.8 rupees: 4s. [142

Reports of the Biochemical Research Foundation of the Franklin Institute Vol. 5, 1938-1939. Pp. vii+42 papers. (Philadelphia: Franklin Institute.) [142

Transactions of the National Institute of Sciences of India. Vol. 2, No 2. Changes brought in Colloids by Dialysis. By Dr. B N. Desai and P M Barve. Pp 39-68. (Calcutta: National Institute of Sciences of India) 3 rupees. [142

Tanganyika Territory: Department of Lands and Mines, Geological Division Bulletin No 12: The Kimberlite Province and Associated Diamond Deposits of Tanganyika Territory By Dr. G. J Williams. Pp. 41+3 plates (Dar es Salaam: Government Printer) 3s [142

Indian Forest Records (New Series). Entomology, Vol. 5, Nos 4, 5, 6. On the Biology of the Parasites of the Teak Defoliators, *Hapalia machæralis* Walk. (*Pyralidæ*) and *Hyblæa puera* Cram. (Hyblæidæ) in Burma, by F. F. Garthwaite and M. H. Desai; Further Notes on the Biology of Parasites of Teak Defoliators in India, by C F. C. Beeson and S. N. Chatterjee, On the Biology and Morphology of *Apanteles machæralis* Wlkn. (Braconidæ, Hymenopt.), by P N. Chatterjee. Pp ii+309+396. (Delhi: Manager of Publications.) 2 rupees: 3s. [142

Dominion of Canada: Department of Transport, Air Services Branch: Division of Meteorological Services of Canada. Canadian Polar Year Expeditions, 1932-33. Terrestrial Magnetism, Earth-Currents, Aurora Borealis. Chesterfield Inlet, Meanook, Saskatoon. Vol 2 Pp. 185 (Ottawa: King's Printer) [142

Instituto Nacional de Tecnologia (Ministerio do Trabalho, Industria e Comercio). O controle de concreto numa construção. Pelo Alberto Pastor de Oliviera Pp. 21 Dosagem racional em tubulação de concreto. Pelo Adhemar da Cunha Fonseca Pp. 52. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [142

Catalogues, etc.

The Basic Cause of Ill-Health. By K. Cookson. Pp. 20. (Slough: Cooksonisers (Slough), Ltd.)

Pyelectan for Intravenous Pyelography. Pp. 2. Kapilon for Vitamin K Therapy. Pp. 2. (Greenford: Glaxo Laboratories, Ltd.)

Industrial Thermometers, Hygrometers, Manometers. (List No. 641.) Pp. vi+64. (London: C. F. Casella and Co., Ltd.)

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Vol 145 SATURDAY, MARCH 9, 1940 No. 3671

ECONOMIC WARFARE AND NATIONAL EFFORT

THE dominant conclusion which emerges from the admirable surveys of the work of the Department of Economic Warfare which Mr Ronald H. Cross has recently given in the House of Commons and in a broadcast talk is that economic warfare is a field which demands very deliberate application of scientific methods if success is to be achieved. Nothing short of a really militant policy, taking full account of the known facts and undeterred by other considerations than its main purpose—that of making it as difficult and as expensive as possible for Germany to obtain her supplies—can be adequate. The task is from the outset more difficult than it was in 1914–18, for Germany now has access by land to the whole of Europe east of France, as well as to the greater part of Asia We cannot afford to neglect loopholes which might be stopped by more efficient organization or a more scientific policy.

One of the great merits of Mr. Cross's surveys is that they direct the attention of the public not only to what is being done but also to the expansion of that work which is still required. That expansion will demand the co-operation of the public to an extent which will only be possible as a result of a really scientific policy and effective campaign of education. There are many, indeed, in Great Britain who still imagine that we shall win the War without undue disturbance of ourselves. Such easy optimism should at least be shaken by these addresses of Mr. Cross. The discipline already accepted by Germany is not so much a sign of defeat as a challenge that must be taken up by all the democracies. Victory in the great cause for which they contend can only be assured by sacrifices worthy of so great a goal and in no way inferior to those which have been accepted by the enemy

The accounts which Mr. Cross has given of action taken and projected, however, still afford grounds for the uneasiness with which the Government's attitude in this important matter is regarded in many influential quarters. The concern which has been expressed by Sir William Beveridge and others that the War Cabinet contains no member designated as Minister of Economic Co-ordination or indeed who would appear well fitted for that part, was not dispelled by Lord Stamp's appointment as adviser to a Cabinet Committee on Economic Co-ordination Recent events, such as the lack of foresight betrayed in a recent debate in the House of Commons on the home production of foodstuffs, have indeed increased it.

Conceived even within the sphere of the Ministry of Economic Warfare, economic warfare is essentially a scientific problem, with all the difficulties involved in conducting operations which bear no relation to normal sound business. So long ago as November an able article contributed to *The Times* argued for an organization on a geographical basis with an economic commander-in-chief, assisted by a small expert economic general staff, corresponding with the organization at the disposal of a military commander-in-chief. Much more is the immense dislocation involved in our transition from a peacetime to a war-time economy a scientific problem which is still incompletely solved. The persistence six months after the outbreak of war of the tragic waste of employment on the scale of a million and a quarter testifies to the absence of

organization to utilize the abundant resources which we possess.

These are among the main considerations which have led to renewed representations for reconstruction of the Cabinet, and administrative machinery on lines which would enable all the activities on the economic front to be co-ordinated as parts of one coherent policy for the vigorous and effective prosecution of the War. Among other speakers, Lord Swinton urged that the Cabinet should include a Minister standing in the same relation to the economic department that the Minister for the Co-ordination of Defence does to Service departments. It is true that Lord Stamp is building up a central staff; he has been assisted from the start by Mr. Henry Clay and Mr. H. D Henderson Prof. J. Jewkes has now been summoned from Manchester and Mr. E. A. E. Robinson from Cambridge, and it would be unjust to infer that Lord Stamp and his staff are offering no advice on prices, wages, labour mobilization, exports or finance, because the Government has no apparent policy on these matters.

It would appear to be probable that everything that machinery for interdepartmental coordination can achieve is already being done through the committee of permanent heads of departments of which Lord Stamp is chairman, or the Economic Policy Committee of the Cabinet, with Sir John Simon in the chair and Lord Stamp in attendance. What is wanted is central and purposive direction applied not only to interdepartmental matters but also to those that are, formally at least, the concern of one department. Only a Cabinet Minister of Economic Co-ordination can be expected to possess the authority and decision necessary to overcome the obstacles presented by the *laissez-faire* attitude of the Board of Trade in regard to exports or location of industry, the negative views of the Ministry of Labour on its own functions or the inadequate conception of the Ministry of Supply, with its autonomous and secretive controls. The advisability of giving careful consideration to the reconstruction of the Cabinet on the lines recommended by the Machinery of Government Committee of 1918 is more and more apparent as the struggle proceeds.

The administrative problem may be one of scientific management, of bringing into the executive and administrative machinery of government the principles which have been elaborated and tested in large-scale industrial and business organizations and indeed in the Services themselves. The extent to which the whole economic effort of the nation is a problem demanding close scientific analysis is indicated further in an admirable survey of civil needs issued as a broadsheet by P E P (Political and Economic Planning) almost simultaneously with the recent debates on economic warfare in the Houses of Parliament. It reminds us, as did the statements of the Minister of Economic Warfare, of the inexorable demands which war makes on us and the inevitableness of personal sacrifice. It also indicates the chaos and danger which may well result if no guidance is given as to cutting down of unnecessary consumption, and no attempt made to define essential civil needs on a rational basis in relation to the elimination of waste, the conservation of our resources and the most effective implementing of our war effort.

In regard to food, for example, that primary and most essential need, if we are to minimize our large imports of foodstuffs without detriment to standards of nourishment, we must make the best use of the food we consume, by utilizing to the full the discoveries of nutritional science during the last twenty years. Moreover, besides the problem of putting everyone in the position to buy the necessary minimum of foodstuffs, there is the further problem of ensuring that those who can afford enough food are not malnourished through ignorance or physical reasons. Where people are already malnourished to the detriment of their efficiency as workers, an unplanned cut in food consumption would undoubtedly increase this malnutrition and inefficiency. At the same time, a proper use of our knowledge of nutrition might enable us to reduce our gross consumption of foodstuffs without any loss, and perhaps even with an increase, of health and efficiency.

The imposition of rationing without such positive action clearly holds dangers. Both eating and cooking habits may require drastic changes if we are to make the best use of our existing supply of foodstuffs and of the reduced supply which war will inevitably entail. There must be an end to the unbalanced or prejudiced pushing of particular food commodities in the private interests of the seller.

The economic use of the national food supply is largely a scientific question, but it will require firm direction; and national interests must override all other considerations in determining the distribution of such commodities as, for example,

barley, between the farmer or smallholder and the brewer. It will be remembered that in 1916 the Royal Society Food (War) Committee, recommending that feeding-stuffs should be fed only to good 'converters' such as dairy cows, calves and pigs, and the production of cheese instead of butter, recommended also the partial or total prohibition of brewing Moreover, the dependence of British agriculture itself upon imported feeding stuffs raises other problems in relation to the reduction of imports, from the point of view of saving tonnage or of exchange.

Generally, it requires more shipping tonnage to import food for animals than to import food directly for men and women. A shift in agriculture to good 'producers' as recommended by the Royal Society Food Committee would involve a considerable reorganization of British agriculture Land formerly used for growing fodder is being turned over to growing food for human consumption. The most effective use of the maximum average which must be the objective of British policy can only be secured by making the fullest use of the scientific knowledge available Such a utilization, coupled with an effective education campaign, leading us to eat differently, involving sacrifice of some imported foodstuffs, and a measure of reorganization in agriculture, should make it possible to reduce our expenditure on food with real advantage to our war effort.

The housing situation also requires scientific analysis and treatment If it is probable that the civil need for housing can be satisfied during the War at very little cost, the impact of a large reduction in net expenditure on housing not only on the building industry but also on the public works contracting industry, the furniture-making industry and numerous auxiliary industries requires consideration. The appropriate utilization of displaced workers from these industries is a major problem of social planning which has yet to be tackled. After the War, and during it, if there be large-scale air raids, the building industry will occupy a key position. Careless disposal of the key personnel such as architects, quantity surveyors and skilled workers might have serious consequences.

Similarly, national expenditure on transport demands close and scientific study. The possibilities in the elimination of excessive expenditure on daily journeys, with all the advantages that might accrue in the saving of health and time as well as transport, have yet to be examined. Staggering of hours and holidays may become inevitable as available transport facilities are restricted, and economies in expenditure on private transport should in turn reduce the annual deterioration on the roads. Moreover, the development of alternative sources of power in place of petrol for transport is a further and essentially technical problem.

In many other spheres such as clothing, the use of fuel and water supplies, much could be done to eliminate waste by suitable publicity campaigns The prevention of atmospheric pollution by more efficient means of utilizing coal in domestic houses and the prevention of riparian pollution are two examples in which the co-operation of scientific workers is important. They could also play their part in directing attention to the preventable waste which occurs through ill-health, the ravages of rabbits, rats, weeds, insect pests or animal pests, through neglect to employ scientific methods of control.

There can be no question as to the seriousness of the economic situation. Direct economic warfare is only one of its facets; equally intense drives are required elsewhere to ensure concerted and intelligent thinking, the elaboration of plans based on adequate scientific knowledge and their translation into immediate and appropriate action. The absence of signs of an adequate plan, of organized thinking and resolute action are disquieting aspects of the situation at the present moment.

We cannot escape, as war proceeds, inroads into our standard of living, and so far the Government has lagged far behind that of France in putting before the people the need for sacrifice. Something more than vague generalities is now required. Should it be decided to adopt the plan of a basic 'iron ration' advocated by Prof. J. R. Hicks, fixing rations of a basic list of necessary commodities, corresponding with basic human needs, at guaranteed prices which would ensure that the whole ration would never cost more than a stated sum within the reach of all, the Government can only win the support of a free people by giving evidence of the most rigorous and impartial examination of the situation, and of its own capacity to take the resolute action demanded. We may well have cause to be grateful if the recent utterances of the Minister for Economic Warfare herald a much closer attention to the economic aspects of the War and a scientific examination of the situation which may give concrete guidance to the call for economy and sacrifice.

COLONIAL DEVELOPMENT AND RESEARCH

WHEN on February 20 the House of Commons turned for a brief space from its preoccupation with the War to listen to Mr Malcolm MacDonald, H M Secretary of State for the Colonies, as he announced the decision of the Government in the matter of the report of the West India Royal Commission, 1938–39, it must have been a source of both pride and gratification to the members that, at a time when every resource is strained in the effort to preserve all for which our society and system of government stand, the loyalty and support which the mother country has received from her colonial dependencies should be met by a no less striking manifestation of solicitude on the part of Great Britain for their inhabitants As already pointed out (see NATURE, March 2, p 342), the statement of future policy in relation to the development and welfare of the colonies then made by Mr MacDonald* not only marks a new departure in the relations, financial and other, of the central and local administrations, but it also extends vastly the field in which the sense of responsibility of the mother country for the well-being of the inhabitants of these territories will be enabled to find effective expression This inter-relation is well defined in the words of the statement itself, that His Majesty's Government, regarding themselves as "trustees for the well-being of the peoples of the Colonial Empire", look upon "the spontaneous and wholehearted support given by the inhabitants of every territory to the common war effort as the best testimony to their appreciation of the way in which that trust is being discharged" , while on the other hand, it is said, "the primary aim of Colonial policy is to protect and advance the interests of the inhabitants of the Colonies (in which term are included . Protectorates and Mandated Territories)".

Mr. MacDonald's announcement is the outcome of no hasty and improvised decision. Indeed, it is stated that this further development of Colonial policy was settled in principle some time ago, and final decisions were postponed only pending the result of the West India inquiry. It has been evident for a considerable period that circumstances, aggravated by the economic depression, not only militated against the social and economic well-being of the inhabitants of, for example, the African dependencies under the Colonial Office, but also were rapidly approaching a stage at which drastic remedial measures, beyond the resources of the local administration, would have to be applied. It is now pointed out that while much has already been accomplished, there is room for further active development of the natural resources of the various territories so as to provide their peoples with improved standards of life

The conclusion at which the Government has arrived, after consideration of the effect of such limited resources derived from agriculture as are available in most of the dependencies, in relation to a policy of steady development, is that many colonies cannot finance out of their own resources the research and survey work, the schemes of major capital enterprise, and the expansion of administrative and technical staffs, which are necessary for their full and vigorous development The old principle that a colony should have only those services which it can afford to maintain out of its own resources is to go by the board, and in future assistance will be given not merely for capital expenditure or material development—in the main the objects of the Colonial Development Fund instituted in 1929—but also the money from new sources now to be provided is to be made available for the maintenance of important works or services over a substantial period of years.

For the sake of clearness, it may not be out of place here to recapitulate briefly the financial arrangements now proposed, and the machinery to be instituted for their employment.

The Colonial Development Fund, instituted in 1929 and limited to a maximum of £1,000,000 a year, will be replaced by a new vote in the estimates for assistance to Colonial Governments up to a maximum of £5,000,000 a year for ten years. This assistance will be available not only for schemes involving capital expenditure for colonial development, but also for helping to meet recurrent expenditure on certain services, such as agriculture, education, health and housing.

Bearing in mind the proposals for research made by Lord Hailey in his "African Survey", the Government proposes to make special provision for research. Hitherto, expenditure on various

* Statement of Policy on Colonial Development and Welfare. (Cmd 6175.) Pp. 8 (London. H.M. Stationery Office, 1940.) 2d. net.

forms of Colonial research has received assistance from the Colonial Development Fund. In future, for this purpose a separate sum will be allocated up to a maximum amount of £500,000 a year.

As regards the manner of allocating expenditure from these funds, the Government will enlist the help of a Colonial Development and Welfare Advisory Committee, which will be composed partly of official and partly of unofficial members.

In the province of research, in the past the authorities have had recourse in dealing with questions of Colonial research to the advice of scientific and technical experts in Great Britain; but they are now anxious to place the system on a wider and more regular basis. It is considered that this object can be best achieved by the establishment of a Colonial Research Advisory Committee. It is not anticipated that the full scale of expenditure will be reached all at once, especially in present conditions; but so far as possible, steps will be taken immediately to give these proposals effect.

It will be seen that this extension of policy in colonial development represents a very appreciable step in advance. Its most marked effects should be immediately apparent in the removal of the restrictions which virtually, if not in terms, confined previous grants-in-aid to non-recurrent capital expenditure and material development. In no departments of colonial administration have efforts at amelioration been so cramped as in the provision for health services and education—both of paramount importance in raising the standard of well-being among the native populations. By a prolonged course of education alone can the object of the health services really be fully attained.

It is natural that in this much enlarged policy of colonial development the first emphasis should be laid on the improvement of the economic position of the Colonies. Although in any consideration of the amelioration of colonial conditions it has come to be almost a matter of course to consider how and in what way the native population is affected, the interests of the white settler are not to be overlooked. On his shoulders in most instances rests the main burden of the development of the natural resources of the territory; and anything which contributes to promoting the improvement of economic conditions must be to his advantage as well as a further stage in progress towards self-sufficiency.

At the same time, even in such conditions, as always, the foundation of the social and economic structure is the native population. It is this consideration which weighs the argument when it is urged that whatever delay may be imposed on development by current conditions and the claims of the vigorous prosecution of the War, some part at least, and that the more urgent, of the expenditure on research may be pressed forward as a first and immediate charge. Among subjects of inquiry, a plea must be put forward for intensive study of the forms and constitution of native society. That the claims of this line of investigation should be stressed at this late date may seem a work of supererogation. Yet it is a question whether even yet the essential need of intensive study of native institutions and beliefs, and the implications of its conclusions, have been fully recognized, even though anthropologists have been attached officially to recent survey work, such as the nutritional survey in Rhodesia; indirect rule itself, prior to its application, requires an investigation of the character of native institutions before it is possible to make use of them in the administration of native affairs. Recent investigations in West Africa, for example, suggest that indirect rule, where it is now in being, may sometimes rest on an uncertain foundation, notwithstanding preliminary inquiry, when dealing with so complex a matter as the seat of authority in an African community. The farther and deeper goes research in the social anthropology of African peoples, the more patent becomes the closely woven nexus of social and religious or quasi-religious relations of the community. It is impossible to touch the part without affecting the whole.

The significance of further and intensive research in social anthropology as a priority condition of the application of measures of colonial development affecting the native should be obvious. There is no measure of amelioration, whether it be in health, nutrition, agriculture, land tenure, education, housing, or social reform generally, which does not necessarily impinge upon, and to some extent modify, some sides of native life. What those sides are, how extensive their ramifications, and to what extent they may introduce further and unanticipated changes in mode of life, to the disadvantage of the community, the anthropologist is better able than anyone else to say. Many mistakes, reacting to the disadvantage of the native population, have been made in the past in default of such expert guidance. The delay which must supervene in the full application of the new policy of development at least gives opportunity for their avoidance from this cause in the future.

THE PLACE OF SCIENCE IN BRITISH AGRICULTURE

Agriculture in the Twentieth Century
Essays on Research, Practice and Organization to be presented to Sir Daniel Hall Pp x + 440 (Oxford Clarendon Press, London Oxford University Press, 1939) 15s net

BRITISH agriculture has always had its problems, its vicissitudes, its hopes, and although still buffeted by forces political, economic and social, it keeps its head erect, conscious of its unique importance and maintaining an undying faith in the return of better times. One impression gained by reading these excellent essays, written by leading exponents of scientific agriculture, and most fittingly dedicated to its Nestor, Sir Daniel Hall, is that of the great difficulties confronting statesmen and administrators when they have to adjust their outlook and their policies to meet new situations, which, in the absence of any long-term plan, have come upon them unforeseen. Until Sir Daniel Hall was appointed to the Development Commission in 1909, scientific knowledge and foresight seem to have been conspicuously lacking in administrative circles, and even to-day they have to contend with reactionary forces, represented by vested interests, the ignorance of science, and that one and only static thing in an ever-changing world, the ultra-conservative mind.

Of the fifteen essays included in the book, four deal exclusively with the relations of agriculture to the State or public authorities, and the rest to scientific and technical advances, mainly in the last forty years The essays adequately cover all branches except that of agricultural engineering Mr. H. E. Dale, formerly principal assistant secretary to the Ministry of Agriculture and Fisheries, has some interesting things to relate about Civil servants, whose traditional silence keeps the outside world uninformed of their functions and powers He admits that order and strength, and not flexibility and freedom of personal initiative, are their peculiar virtues, and tells us that they are as averse from official intervention in the business of agriculture as are the farmers themselves. The growth of this intervention has arisen from the urgent need of keeping agricultural producers on their feet. The policy of assisting home producers by supporting prices, or by compensating them for price reductions due to world conditions, has been the dominant note of all recent legislation; unfortunately, as several writers point out, it has not been accompanied by any direct legislation, for example, on distribution costs, to help the consumer Dr J A Venn shows how the annual cost of supporting agriculture has lately run into a sum of the order of £60 million Prof H H Ashby contributes a dispassionate digest of agricultural legislation since 1910, but shows his teeth when he writes "Neither the State nor agriculturists have ever defined the chief aims of agricultural policy, and for the greater part of the time both parties are pursuing conflicting and to some extent mutually destructive aims" Prof J A Hanley recounts the rise and progress of agricultural education since its beginning in 1890, ending on a cheerful, if controversial, note that "the attitude of farmers and farm workers towards education and research has changed completely—their confidence has been won"

Less optimistic is Prof. C S Orwin in his account of "The Farmer's Business". He states that "the evolution of the industry has stopped short at a point half-way between peasant production and scientific management". He urges strongly the use of simple accountancy methods by farmers, but has to deplore that "the practice of scientific book-keeping, as the only means to correct the policy and the practice of the farmer, is so rare as to be virtually non-existent".

Prof J A Scott Watson writes more cheerfully, acknowledging fully the many advances made by applying science to practice. He admits, however, that there has been no essential advance in the art of tillage, and states that "the recipe for success in breeding [stock] is still an ounce of science to a pound of intuitive judgement and half a stone of luck".

In the essays dealing mainly with scientific and technical developments, some of the authors pursue a rigidly historical sequence, which is apt to make 'heavy' reading, whilst others concentrate on the present position using history as a background. Notable among the latter are Sir John Russell's lucid account of "Soil Science in England", and the valuable essay by Dr. C. Crowther on "Some Problems of Animal Nutrition". Sir George Stapledon's treatise on "Grassland" deserves special attention as coming from the pen of a pioneer, a thinker who has shed his academic blinkers, and—one must add—as a 'feeler', for he confesses: "I am sufficiently unscientific, or possibly sufficiently scientific, to permit feeling to colour my scientific judgements and opinions". Dr. R N. Salaman has a fascinating tale to tell about the rise and progress of research in plant viruses: and Mr. R. G. Hatton's account of

developments in fruit-growing discloses a remarkable story of scientific achievement which is probably unknown to most of those who do not work in his field

The technical essays, in particular, will be of great value to students of scientific agriculture (and for this reason the book should have been provided with an index), and if they are read by the humanist, they can scarcely fail to convince him that although progress may often originate with the practical craftsman, it is science alone that can evaluate inventions and discoveries, stabilize them, and use them as a basis for further advance It is probably true to say that in the last forty years—the period covered by the book—science has been responsible for many more advances than has untutored practice And by science we mean controlled observation, measurement, and sound reasoning, not (with due respect to Sir George Stapledon) "feeling", although it may play its part in stimulating research and in applying the results to human betterment Regarded as literary efforts all the essays are well-phrased and lucid The only criticism that can be advanced is that some of them are rather overburdened with facts, a little more play of the scientific imagination, a few more generalizations and ideas, and a livelier style of writing would have leavened the whole and increased its general appeal Nevertheless, the book is in every way a notable one, and a worthy tribute to an exceptionally worthy man.

E H Tripp

ELECTRON DIFFRACTION

Theory and Practice of Electron Diffraction
By Prof G P. Thomson and Dr. W Cochrane Pp xii+334+10 plates (London Macmillan and Co, Ltd, 1939) 18s net

THE chief interest attached to electron diffraction at the time of its discovery was the abundant support it brought to the new and exciting ideas regarding a wave mechanics of material particles which de Broglie, Schrödinger and others were then applying with such marked success to the remodelling and rationalization of the Bohr atom The discovery that electrons are diffracted by crystals left no doubt concerning the reality of the waves associated with matter, and the gratifying agreement between observed wavelengths and those calculated from de Broglie's formula afforded welcome evidence of the correctness of the wave model of the atom and of wave mechanical conceptions in general The waves associated with matter had, so to speak, been brought into the open, and made available for direct examination.

It is not surprising that experimenters and theorists flocked 'in all directions', as the Russians have it, to this new field Electron diffraction, like other recently discovered effects in these days of high-pressure research, enjoyed a period of intensive, not to say feverish, investigation during which the main facts and implications of the phenomenon were quickly laid bare. The technique of producing and recording patterns was rapidly improved, particularly for electrons of high speed. All diffraction effects observed with X-rays were shortly duplicated with electrons, including diffraction by molecular gases. The first rough checks of the de Broglie formula were confirmed by precision measurements The first attempts were made to polarize electron waves by reflection. The relative intensities of diffraction beams were used to calculate the structure factors of crystals and form factors of atoms, with results in general accord with expectations based on existing theory. The dynamical theory of electron diffraction was developed along lines paralleling those followed in the theory of X-ray diffraction. Further, what now seems of prime importance, G P Thomson made the first applications of electron diffraction to the study of corrosion films on metal surfaces

These developments were greatly facilitated by the huge store of knowledge and experience which had accrued from more than twelve years of intensive study of X-ray diffraction The investigators of electron diffraction had at hand not only a model and guide for their work, but also an enormous fund of data regarding crystal structure and constants There was some feeling at the time indeed that this store was rather more enormous than one might wish. All the 'easy shots' in crystal analysis had already fallen to X-rays; electron diffraction had arrived only in time for the cheering —or so it seemed. It was recognized that electrons were suited to the study of exceedingly thin films and to surface layers—fields from which X-rays, because they are scattered but feebly by atoms, are excluded—and that here much of importance was to be learned It is doubtful, however, if anyone realized how extensive and rich a field this is; if anyone realized that in their respective fields, electrons would, in certain respects, be more useful for the analysis of crystals than X-rays.

The flow of energy in the primary electron beam is much greater ordinarily than that in the primary X-ray beams. The exposure times for electrons are consequently shorter (of the order of one second) and patterns are recorded at a greater rate, in spite of the fact that with electrons a vacuum must be broken and re-established at frequent intervals for changing plates and specimens The wave-lengths of high-speed electrons are much shorter than those of the characteristic X-radiations, and this also is advantageous as it results in a greater content of information in the diffraction pattern per unit solid angle about the primary beam Electron patterns which show twenty-five or thirty Debye-Scherrer rings are not uncommon, and patterns have been obtained which show as many as forty

Even in the matter of diffraction phenomena, electrons have produced effects not observed with X-rays The so-called cross grating patterns, produced by the copious scattering of the extremely short electron waves, are of this class, as are also the Kikucki line patterns which reveal the diffraction of electrons elastically scattered in random directions within a crystal

All these matters and much else beside, Thomson and Cochrane have set forth in a scholarly and pleasing manner in this new and welcome book on electron diffraction—the first of its scope in English About one third of the book is devoted to theory. A chapter on general considerations of wave phenomena is followed by more particular examination of the concept of material waves, of crystal structures and diffraction effects Ewald's invaluable conception of the reciprocal lattice is explained and employed throughout in the interpretation of patterns Bethe's dynamical theory of electron diffraction is explored in considerable detail in a later chapter, and in another Darwin's theory of polarization is briefly reviewed.

The greater part of the book is given over to experimental technique and to a critical examination of results so far obtained in investigations of thin films and surface layers of gross specimens Separate chapters are devoted to oil and grease films on metal surfaces, to oxide layers, and to the still controversial question of the physical nature of surfaces which have been mechanically polished A chapter on the diffraction of low-speed electrons serves chiefly to reveal how much is yet to be learned in this important field Elsewhere, also, one is struck not only by how much has been accomplished but also by the vast amount of work still to be done The book is not free from errors What book in its first edition is? But such as have been noted are few, obvious and innocuous

The authors are to be congratulated on having produced a timely survey and appraisal of our present stock of knowledge regarding the diffraction of electrons C J DAVISSON

DESIGN IN AIRCRAFT

Aircraft Design
Vol. 1 Aerodynamics Pp xii + 215 + 8 plates 13s 6d net Vol 2 Aerostructures Pp xiii + 308 + 10 plates 16s net By C H Latimer Needham (London Chapman and Hall, Ltd., 1939)

IT is difficult to assess the value of these two books without understanding to whom they are addressed The author's treatment of his subject is more applied than academic, making it appear to be a designer's handbook rather than a student's text-book Even then "he falls between two stools", giving neither enough facts and figures for the one, nor fundamental proofs for the other. Nevertheless the subject matter, so far as it goes, is useful and logically treated, and the volume should find a place in any library of aeronautical literature.

Vol. 1, "Aerodynamics", could have been better named "Aerodynamic Design"; it treats the subject entirely from this point of view In this respect the author has made some unfortunate choices in his examples In the remarks upon the properties of aerofoils, R.A.F. 15 is the one chosen. This has long been of nothing more than academic interest to the designer The chapter dealing with the variation of the properties of an aerofoil with its shape is an excellent concept, and gives the designer exactly the lead that he so often needs, having to produce an aerofoil to fulfil a certain performance. The discussion of the effect of Reynolds' number on drag is dangerously vague, and no mention is made of the fact that the roughness of the surface is a vital factor when using results comparatively Also the effect of structural form, biplane or monoplane, and plan form on induced drag seems to be none too clear.

The chapters on variable lift devices and airscrews are good, being more of an applied nature, but a fuller reference to B. M. Jones's classical method of drag analysis would have been valuable.

Vol. 2, "Aerostructures", is much more clearly defined in its presentation, and gives the impression that here the author is more at home with his subject. Again his choice of examples might have been more up to date His figures for the comparison between a biplane and a monoplane are based on practice of several years ago. There is an excellent chapter on weight distribution and its estimation, a subject which has seldom been treated properly or as fully in other published text-books Load factors are also dealt with fully, another subject none too clearly treated in other books Mention should have been made of the possibility of these being varied as our knowledge of the principles of aerodynamics is extended

When the author reaches the really practical aspects of design in chapters such as wing design, under-carriages, and metal construction, he becomes very sketchy in his treatment It is, of course, impossible to treat such subjects in any other fashion in so small a compass, and it might have been better to have covered a smaller field more thoroughly For example, a chapter on testing scarcely comes within the province of "Aircraft Design" The subject-matter in these chapters is accurate and useful so far as it goes One is tempted to hope that the author will find it possible to extend future editions, and give his readers the benefit of the detailed knowledge of this part of the subject that he obviously possesses.

PROGRESS IN BIOCHEMISTRY

Annual Review of Biochemistry
James Murray Luck, Editor, James H C Smith, Associate Editor Vol 8 Pp ix+676 (Stanford University P O, Calif· Annual Reviews, Inc, 1939.) 5 dollars

THE editors emphasize the need for critically appraising contributions of major significance rather than attempting a mere catalogue of papers, so that presumably this year's reviews, of which there are twenty-five, have been written from this point of view. Even so, they are mostly so highly specialized as to be too difficult for anyone but the experts

Under the heading biological oxidations, Mr Dixon notes the discovery of a new coenzyme-nucleotide and of new catalytic flavoproteins In point of fact, rapid progress is being made in this group, but it requires a year or two yet before the results can be pulled together and a clear story made out of them

The enzymes are dealt with in two sections, proteolytic and nonproteolytic The work is now mainly chemical and slow progress is being made K Myrback devotes a few pages to the discussion of the various amylases it is now admitted that they belong to clearly different groups producing from starch either alpha maltose or beta maltose or stable dextrins which vary in nature. It is inferred that the starch molecule cannot be so simple as deduced from the formula of Haworth. What a difficult problem starch presents! It has perhaps the largest literature of any compound and is one of the commonest of substances.

Karl Freudenberg selects lignin for discussion among polysaccharides and has put forward what seems to him the most logical conception of spruce lignin structure The fundamental type unit, a skeleton containing nine carbon atoms, is a substituted phenyl propane, and it is considered that lignin is composed of a number of similar units connected through an ether linkage between phenol-hydroxyl and the carbinol group of the side chain. The origin of lignin in the plant can only be conjectured It may come from pectin, but it is more probably derived directly from hexoses The relation of lignin to the many phenolic glycosides also requires consideration X-ray studies are doing so much to advance the knowledge of the structure of compounds of biological interest that it is valuable to have a note on this subject from W T. Astbury

Chapters follow on fats, proteins, and sulphur compounds and on several branches of metabolism

There is more work on hormones than ever, particularly in the steroid group relating to sex and adrenocortical hormones John Freud and two other Dutch workers contribute a very useful summary in which they cite 550 papers and books. The vitamins are distinguished as water-soluble and fat-soluble There is an interesting note by C H. Best and J H Ridout of Toronto on choline, which acts in the diet to inhibit the accumulation of neutral fat and cholesterol esters in, and accelerates their disappearance from, the liver

Reference has only been made to half the reviews, it must suffice to show how much work is going on and how valuable these reports are. Messrs Murray Luck and James Smith have once more earned the thanks of their biochemical colleagues

PROTECTION OF THE RADIATION WORKER*

BY DR. G. W. C. KAYE, O.B.E., F.R.S.
NATIONAL PHYSICAL LABORATORY

THE basic ideas of protection for radiation workers by the use of remoteness and absorptive shielding are obvious enough: the remarkable thing is the time it took to secure their observance. Naturally, the X-ray tube as evolved by Röntgen and his contemporaries in 1895 onwards was entirely unprotected, but although the explanation was not clear, the dangers of superficial injuries through indiscriminate exposure to the rays had become evident within a few months of their discovery. There were those who attributed the injuries to personal idiosyncrasy, electrical effects, ultra-violet rays, platinum particles from the X-ray tubes, platinocyanides from the fluorescent screens, etc. Among other things, red silk and thin rubber sheet were actually advocated as preventives! Röntgen himself probably escaped hurt for the reason that he conducted his experiments, which were mainly photographic, with the X-ray tubes inside a metal box.

In 1898, a committee appointed by the Röntgen Society collected evidence, much of it confusing, on the harmful effects of the rays. Presently, the principle of absorptive shielding began to emerge, and a distinction was drawn between the effects of 'hard' and 'soft' X-rays. But developments were slow, and so it happened that for many years, protection for most workers continued to be rudimentary or nearly non-existent and, whether owing to apathy or ignorance, injuries and deaths continued to result. The position was aggravated during the War of 1914–18, for many of the X-ray diagnostic sets on which the British army depended were of relatively primitive design. Such outfits, which wholly employed induction coils and gas tubes, were necessarily of restricted output, and exposures, particularly in screen examinations, were often formidable.

BRITISH RECOMMENDATIONS

A series of casualties to a number of prominent X-ray workers during the next few years definitely aroused public opinion. It had become apparent that in addition to general deterioration of health, the signal effects were of three main types: (*a*) injuries to the superficial tissues (usually of the hands) which, with neglect, might become ulcerated or even cancerous; (*b*) prejudicial changes in the blood which might progress to fatal anæmia, and (*c*) derangements of internal organs. More effective protection for the X-ray worker was clearly necessary; but no less important to the X-ray worker was the absolute safeguarding of the patient against accidental over-exposure, particularly in screening and therapy. In 1921 the British X-ray and Radium Protection Committee was formed under the chairmanship of Sir Humphry Rolleston, the members being nominated by various radiological and scientific bodies. It speedily got out a series of protective recommendations which, incidentally, were the first of the kind to be issued by any country, so giving a lead to the world in these matters. These recommendations took cognizance of three primary dangers: (*a*) undue exposure to radiation; (*b*) high-voltage risks from exposed conductors, (*c*) undue exposure to toxic gases produced by coronal discharge. Since 1921, the Committee has revised the recommendations on a number of occasions. In the light of greater knowledge and experience, the recommendations gained in precision and detail, and presently extended their scope to include film storage, electromedical apparatus and ultra-violet therapy.

The attention of the younger workers may be directed to the difficulties with which the British Committee was confronted in its first efforts to specify and standardize protective measures. The need was great, for the conditions in the majority of X-ray departments were thoroughly unsatisfactory in those days. The Committee realized the pitfalls of a biological unit of dosage, but a bigger obstacle was the absence of an accepted physical unit of quantity of radiation. Only a few workers had attempted to make or utilize physical measurements which could be looked upon as significant or trustworthy; and the best the Committee could do was to try to translate into specific recommendations a sort of grand average of the protective measures which could be gleaned from the working conditions of a number of experienced radiologists who had escaped injury and still enjoyed normal health. A committee which attempts to put forward safety recommendations must err, if it errs at all, on the side of caution, and it was perhaps not surprising that at the first onset the recommendations were regarded by

* Substance of the fourth Stanley Melville Memorial Lecture delivered before the Society of Radiographers on February 10.

some as unnecessarily drastic, and that the embryonic efforts of the British industry, which backed the Committee's work loyally and wholeheartedly, to provide adequate protection against stray radiation, was deprecated in some quarters as heavy, clumsy and costly, and too cramping for the work of the radiologist But presently the heavy lead-protected boxes and the like departed in favour of the self-protected X-ray tube in which the full degree of lead protection laid down by the Committee was incorporated in the tube itself, and so made it possible with lighter weight and better mechanical designs to restore the freedom of action to which the radiologist was accustomed

Looking backward, it is scarcely possible to over-estimate the progressively beneficial influence of the Committee's recommendations on the well-being of the radiation worker, whether in hospitals or industrial and research establishments, as well as on the development and design of X-ray equipment The Ministry of Health and the Ministry of Pensions gave the recommendations their support, and the National Physical Laboratory collaborated by inspecting some hundreds of hospitals and equipment from the point of view of the recommendations Furthermore, thanks chiefly to the activities of an Inter-Services Advisory X-ray Committee, which has functioned since 1926, the three British defence services entered the present war with X-ray departments and equipment of which the general standards of safety conform to the Protection Committee's requirements as fully as those of civilian hospitals

International Recommendations

In 1928, at the second International Congress of Radiology at Stockholm, the British Committee submitted proposals based on the British recommendations as a basis for international agreement, the outcome being that they were adopted as international recommendations. An International Protection Commission was also formed with representatives from Great Britain, United States, France, Germany, Italy and Sweden, Dr Melville and Dr. Kaye being elected secretaries. These recommendations have been revised triennially by the Protection Commission on the occasions of the successive international congresses held in Paris, Zurich and Chicago, and would no doubt have come up again in Berlin this year under happier conditions. Meanwhile, the international recommendations have been adopted in principle throughout virtually the civilized world. They have been implemented by more detailed national recommendations drawn up by protection or safety committees in a number of countries.

X Ray Protection

From the first, the British recommendations stressed the obvious value to both operator and patient of enveloping an X-ray tube as completely as may be with protective material of a thickness adequate for the X-ray voltage concerned. Such thickness is almost invariably stated in terms of lead, since this is the most effective and convenient absorbent readily available at a reasonable cost. The recommended thicknesses gained in precision as two major steps in progress came about The first step was the adoption at the Stockholm International Congress of the international röntgen as the unit of quantity of X-radiation, based on an air-ionization method of measurement under specified conditions. The second step was the adoption by the International Protection Commission of a maximum 'tolerance dose' of X-rays While there are a number of uncertain variables which do not lie within the province of physics but are wholly biological, the erythema dose is commonly accepted on broad grounds as an index of biological response for the average individual, the tolerance dose being taken as 1/1,000 of an erythema dose in three working days, under conditions when the whole body is irradiated. Estimates of the X-ray erythema dose depend on the exciting voltage, but, on the average, evaluate it as equivalent to about 600 röntgens (r.), so that the tolerance dose corresponds to 0·2 röntgen in a normal working day of 7 or 8 hours, or 1 röntgen per working week of 5 days, or 10^{-5} röntgen per second The protective lead thicknesses for primary X-ray beams which are given up to 600 kv. in the latest International and British recommendations are in general harmony with this tolerance figure under average conditions, corresponding in actual fact to an initial dosage rate of about 2 röntgens per minute at the point to be shielded.

When an X-ray equipment is tested, stray radiation may be evaluated either by a convenient form of dose meter or a Geiger counter, or by carrying on the person a portable ionization chamber of small capacity, or a photographic film. In point of fact, such a film test is very sensitive, blackening which is 'just clearly visible' corresponding (with standard development) to about 0·01–0·02 röntgen (that is, about 1/20–1/10 of the daily tolerance dose), in the case of X-rays of qualities associated with, say, 100–200 kv. The corresponding figure for gamma-rays is about 0·1 röntgen (that is, about one half of the daily tolerance dose).

As regards the protection for X-rays from higher voltages, Mr. W. Binks and I have recently shown, on the basis of theoretical and practical data relating to photo-electric, scattering and nuclear

Exciting voltage (pulsating)	Total lead protection required to give the tolerance dosage rate of 10^{-5} r./sec. at 1 metre distance with 1 milliamp tube-current (X-rays emitted perpendicular to electron beam)	
	Calculated values (Kaye and Binks)	Experimental measurements (Bouwers and van der Tuuk)
400 kv	18 mm lead	17 mm lead
600	40	36
800	60	57
1000	80	79
2000	175	—
5000	290	—

absorption processes, that it is possible to forecast the appropriate protective lead shielding for any voltage We have somewhat prophetically extended our calculations up to 5,000 kv , though, in practice, 2,000 kv is roughly the highest voltage at which X-rays have so far been generated The validity of the calculations, at any rate up to 1,000 kv., is supported by the good agreement with some experimental results since published by Bouwers and van der Tuuk This is shown in the accompanying table, where it will be noted that the lead protection required for 1 million-volt X-rays is about 3 inches, for 2 million-volt rays 7 inches, and for 5 million-volt rays nearly a foot.

Incidentally, if we may, not unfairly, regard the X-radiation from a 2-million volt tube as comparable in quality with gamma-rays, then at 1 metre distance from such a tube operating at constant potential, the maximum X-ray output, which is of the order of 210 röntgens per minute, corresponds to the gamma-ray emission at a like distance from 16,000 grams of radium, a figure the magnitude of which may be contrasted with the total of 1,000 grams known to be isolated in the world

Radium Protection

The problems which present themselves in protecting radium workers are more acute and troublesome than with X-rays. A knowledge of the radium contents of radium sources is naturally of service in this connexion. Such measurements were first put on a satisfactory footing when, following the formation at Brussels in 1910 of an International Radium Standards Committee with the late Lord Rutherford as chairman, an International Radium Standard was set up in Paris in 1913, thanks to the skill of the late Mme. Curie and the generosity of the late Sir George Beilby. In the same year, the latter also presented to the National Physical Laboratory the British National Radium Standard, which had been calibrated in terms of the International Standard, and which has since formed the basis of test of nearly 200 grams of radium.

Protection from alpha- and beta-radiations (which are virtually all absorbed in the skin) is fairly readily achieved in the case of most forms of radium manipulation As regards gamma-radiation, the position is less satisfactory than with X-rays Progress came when the Fifth International Congress of Radiology in 1937 accepted the rontgen as a unit for measuring gamma-rays as well as X-rays. Furthermore, the International and British Protection Committees were led tentatively to assume, on the evidence available, that the human body is equally susceptible to X-rays and gamma-rays, and adopted the same tolerance dose for both radiations, namely, an average dose over the whole body of 1 röntgen per working week There is, however, some divergence of opinion on this point, certain workers maintaining that the tolerance dose should be smaller for gamma-rays

It should be noted that X-ray protective lead values do not apply to gamma-rays, materials lighter than lead being normally more effective against gamma-rays than X-rays The protective thicknesses for gamma-rays may be estimated sufficiently accurately by assuming that the absorption is proportional to the density. Thus, the introduction of tungsten alloys, with a density half as much again as that of lead, has resulted in smaller and more compact radium 'bombs' without sacrifice of protection. Incidentally, the 'safe working distances' for radium bombs, calculated from the tolerance dose, are less than is often imagined , for example, the safe distance for 1 gram of completely unprotected radium is no more than 5 yards, which is reduced to 1 yard or so by enclosure in a lead bomb with 5 cm. walls. By the same token, there is no necessity, apart from questions of air raids, to locate properly designed and protected radium safes at extravagantly large distances from the personnel.

Electrical Precautions

The practice in the pioneer days of Geissler discharge tubes, of using thin copper wire, unprotected except by silk or cotton covering, to connect the high-tension poles of induction coils or electrical machines to the terminals of discharge tubes, was a legacy which persisted with gas X-ray tubes for many years, for although an unexpected electric shock for the personnel was definitely unpleasant, nothing more serious was likely to follow. Many will recall the slack or dangling high-tension leads which carried, usually in the dark, currents at many thousands of volts, sometimes only a matter of inches from the patient or attendant. Heavier high-tension leads followed in due course, but with the advent of larger coils, and particularly of high-tension transformers, with or without condensers, the power developed was such

that greater caution was necessary, and, indeed, fatal accidents began to occur.

The present-day solutions for shock-proofing X-ray outfits take two major forms. One is the shock-proof X-ray tube combined with high-tension cable which, provided with heavy rubber insulation and earthed metallic sheathing, is both shock-proof and sufficiently flexible not to restrict mobility unduly. The other is the complete enclosing of X-ray tube and high-tension transformer in a common earthed metal container filled with a dielectric such as transformer oil or, more recently, 'freon'

Ventilation and Lighting

Nowadays there are no two opinions about the Protection Committee's advocacy of light schemes of decoration for all rooms (including photographic dark rooms), together with large windows affording good natural lighting and admitting sunshine and fresh air whenever the rooms are not in use A bigger step was the introduction of artificial ventilation into X-ray departments The importance to the operator of generous ventilation is now recognized as second only to that of protection, particularly where apparatus is not corona-free, or the control room is not completely isolated from the treatment room. In some countries, notably the United States, elaborate schemes of air-conditioning are employed.

Mention should here be made of the importance of directional ventilation in preventing the inhaling of radioactive dust or radon during the prolonged manipulation of unsealed radium salt, radium ore, etc. ; cases of radium poisoning have occurred for lack of such precautions

Finally, this is perhaps the most convenient place to make passing reference to the manner in which the problem of fires associated with film storage was solved by the introduction of non-inflammable cellulose acetate film, in place of the highly inflammable nitrate film.

Neutron Protection

The problem of protection for the worker with neutrons seems likely to have a wider interest before long, in view of the invention of the cyclotron by Lawrence and the immense yield of neutrons which can be so obtained. It would appear from recent researches that neutrons can be measured directly in röntgens with reasonable accuracy, and that the biological activity of neutrons may be up to eighty times that of X- or gamma-rays, being probably dependent on the cell structure. In the interests of safety, therefore, it seems well to assume at present that the tolerance dosage rate for neutrons is of the order of 1/100 of that for X- and gamma-rays, that is, about 10^{-7} r /sec.

As regards the protection of personnel against neutrons, the task would be the easier if human tissue were not so effective in absorbing neutrons. Whereas in the case of X- and gamma-rays, the light elements present in tissue are only slightly absorptive, these same elements (or at any rate, the hydrogen) have properties the very reverse where neutrons are concerned On the other hand, hydrogen-bearing materials such as water or paraffin, if placed around a neutron source, can be turned to account in slowing down and partially absorbing the neutrons before they reach the personnel. In practice, tanks of water or paraffin 50–100 cm. across are used for screening purposes. About 50 cm. of paraffin reduces the total number of neutrons to about 1 per cent, while a few per cent of boric acid in water reduces the slow neutron activity to about one third of that produced by water alone Having by such means achieved as much absorption of the neutrons as is practicable, further reliance is then placed, as with X- and gamma-rays, on remoteness of the personnel from the neutron source.

International Monument to X-ray and Radium Martyrs

What I have tried to set down in this memorial lecture is largely intended for the younger generation who, equipped as they are, like any modern army, with adequate defensive measures, will, I hope, sometimes spare a thought for those X-ray pioneers who, undaunted by long and sometimes unbearable suffering, which drugs might utterly fail to relieve, and which was perhaps followed by mutilating operations or a cruel death, continued to apply themselves indefatigably to perfect the use of Röntgen's discovery for the benefit of humanity Their martyrdom prepared the way which rendered the present use of X-rays free from danger

Such matters have a world appeal, though it was in less troubled days that the German Röntgen Society erected in Hamburg a monument to the X-ray and radium martyrs of all nations. The monument, which was unveiled on April 4, 1936, takes the form of a simple rectangular column of sandstone surmounted by a laurel wreath. The names of radiologists, radiographers, physicists, chemists, laboratory workers and nurses whose deaths were due to work with X-rays and radium are engraved on the sides. The total is 169 names spread over fifteen different nations : though it is probable that the list is now by no means complete, nor does it attempt to take cognizance of the large number of less serious casualties.

FOOD PRODUCTION AND FOOD CONTROL*

By SIR JOHN BOYD ORR, F.R.S.,
ROWETT RESEARCH INSTITUTE, ABERDEEN

IN anticipation of the War, the Foods (Defence) Plans Committee, working in co-operation with the trades concerned, prepared an elaborate scheme of food control for Great Britain Excellent though this scheme is in some respects, it is not sufficient to deal with the situation. It does not take account of the fact that, even before the War began, the diet of the poorest third of the population was not up to the standard we now know to be necessary for health This is the weakest part of the food front. Our food plans should be directed first and foremost to bring the diet of these people up to the standard If they have sufficient, we need not worry about the rest of the population

The present system of rationing and price fixing cannot bring about an equal sharing of the available food Coupons have been issued for 4 oz of butter and 4 oz. of bacon per week. Even in peace time, when prices were lower, many families could not afford to purchase these amounts. Consequently, we have people with coupons who cannot purchase the rationed amount because they have not the money, and people with plenty of money to purchase the additional amounts they want, but cannot get them because they have not the additional coupons This fosters an illicit trade in coupons and food which defeats the object of rationing If the illicit trade does not develop quickly enough, food remains unsold. As the price rises the amount unsold increases until it becomes necessary to increase the rationed amount, so that those with money can purchase more. It is impossible to have two systems, rationing by price and rationing by amount, operating in the same field without creating anomalies. If rationing is to be efficient and to apply to the whole population, the rationed amount must be within the purchasing power of everybody

Nor does price fixing necessarily benefit the poor. Maximum prices tend to become the minimum. Some commodities have a wide range of prices. Pooling and price fixing will tend to raise the price of the cheapest qualities, which are those that the poor use Then again, the poor get a less expensive distributive service than the well-to-do. Prices are likely to be fixed on the higher costs of the more expensive service, and the poor may be forced to pay for a service which they cannot afford and indeed will not get.

* The arguments of the present article are set forth at length, with additional data, in a booklet "Feeding the People in War-Time", to appear shortly (London Macmillan and Co, Ltd)

It is worth while reconsidering the food policy of Great Britain. We are only at the beginning of what may be a long, grim struggle. The issue will depend as much upon the powers of endurance and the morale of the civilian population as on the efficiency of the fighting forces Next to having a cause worth fighting for and worth dying for, the most important factor for morale is food. In the War of 1914–18, we sustained serious reverses without any loss of spirit, but there was a grave danger of war-weariness in the food shortage of 1917. Our food policy should be designed to raise to the highest possible level national health and physical fitness, upon which morale and powers of endurance so largely depend. It must, therefore, be based upon nutritional needs.

We should first ascertain the total needs of the population, and then determine how these can best be met, keeping in view the possibilities of increasing home production and the need for using the minimum amount of shipping space and foreign exchange for food imports

In the first place, we must provide more protective foods to bring consumption among the whole population up to the level among the well-to-do, which is about the level required for health. Then we must provide more energy-yielding foods to meet increased energy expenditure due to the War Unemployed men and men in sedentary occupations need only about 2,500 calories per day Many of these will be drawn into industry or the fighting forces In the former case their needs will increase to between 3,000 and 3,500 calories, and in the latter case to about 4,000 calories. We must make provision for a total increase of probably between 10 and 20 per cent.

We are thus faced with the problem of increasing our total food supplies at a time when we must economize in shipping space and in foreign exchange; and if we plan to have the whole population adequately fed, we have the further problem of adjusting prices to purchasing power at a time when the cost of food is rising.

In normal times, about two thirds of the total food supplies of Great Britain are imported. Including feeding stuffs for animals, this takes nearly 20 million tons of shipping per annum. Home production must be increased to the utmost limit and the increase should consist of essential foods which are costly to import in terms of shipping space or foreign exchange. The potato should come first on the list. It is the most

important crop in war An acre of potatoes yields twice as much food as an acre of wheat, and it is the safest crop to take out of newly ploughed-up pastures In the War of 1914–18, the yield of potatoes from old pastures averaged 7·1 tons per acre compared with a pre-War average of 6·2 tons on ordinary potato land The potato is of special nutritive value; it is our main source of vitamin C. In Great Britain the average consumption is only about 9 oz. per head per day, though in some families it is as high as 23 oz In Belgium the average consumption is 19 oz. and in Germany it is 16 oz We could, with advantage to national health, increase consumption by at least 50 per cent

The allotment campaign will lead to an increased consumption of vegetables It is estimated there are about 3½ million gardens in Great Britain, and the number of allotments is likely to be brought up to nearly 1½ million Out of a total of between 10 and 12 million households in the country, there will thus be nearly 5 million wholly or partially self-supporting in vegetables If our canning factories are running to full capacity in the summer and autumn, building up a store of preserved vegetables for winter use, and if the distribution of farm-grown vegetables be better organized to reduce the gulf between what the producer gets and the consumer pays, it should be possible to bring consumption of nearly the whole population up to about 6 oz per head per day, the level among the well-to-do

Milk is the most important protective food There is already sufficient milk in Great Britain to bring consumption among the poor, at present less than a quarter of a pint per head per day, up to nearly two thirds of a pint. There should be no great difficulty in making milk, which is at present surplus to the liquid market, available on a cash and carry basis at a price within the reach of working-class families with children

Milk, vegetables and potatoes between them contain all the food constituents necessary for health If everybody has sufficient of these, there need be no malnutrition If we have the right agricultural policy we can produce sufficient for the needs of the whole population, without reducing the pre-War output of other foods.

With sufficient of these three protective foods, we could, if we were forced by lack of shipping space or foreign exchange, limit imports to the cheap, easily carried, energy-yielding foods. The following table shows the estimated storage space, energy value, and price of some of the main foods we import.

The import policy of Great Britain is, of course, affected by trade and other considerations. Thus, for example, we shall import food from eastern Europe, not so much because we need it as to keep it out of the hands of the enemy. Considering only nutritional needs, however, priority in imports should be given to bread and fat, until we have a reserve which puts us beyond the danger of a shortage In 1914–18 we tried to get a reserve of thirteen weeks' supply, but could not maintain it

	Approx shipping space (cu ft per ton)	Approx energy value (1,000 cal per cu ft shipping space)	Cost of 100,000 cal
Sugar	45	83	4s 6d
Wheat	50	56	5s. 6d
Fats & tallow	80	118	8s, 0d
Dried fruits	50	55	21s
Cheese	60	56	39s.
Frozen beef	95	26	40s.
Eggs in shell	120	12	75s

at that level With the uncertainty of the present War, we should have at least a six months' reserve of wheat and fat Of the other foods, sugar is the cheapest energy supplier in terms both of money and shipping space, and would probably be put next to wheat and fat in the list.

If we had sufficient of these energy-yielding foods, together with sufficient milk, vegetables and potatoes, we might be reduced to a spartan diet, but there would never be any need for us to capitulate owing to food shortage. A sufficient amount of the energy-yielding foods could be imported with less than a third of the pre-War shipping space devoted to food and feeding stuffs.

Though these three protective foods and three energy-yielding foods might well form the basis of a national dietary in war-time, it is not suggested that the diet of any part of the population should be reduced to these. Even if shipping space were reduced to a minimum, we would have, in addition to these, all the other foods we can produce at home, and it is exceedingly unlikely that the shipping position will ever be so bad that we cannot continue to import other foods.

The most difficult problem is not the maintaining of supplies to meet nutritional needs, it is, as it was in peace time, one of bringing a sufficient amount of the right kind of food within the purchasing power of working-class families with children It has already been decided to subsidize food It might be advisable to confine the subsidies to the absolutely essential foods and to make it sufficient to bring the price of these within the purchasing power of every family.

To provide for the different physiological needs and for different likes and dislikes, it would be necessary to leave a margin of money for the purchase of other foods. Thus, for example, if milk, vegetables and potatoes, bread, fat (butter or margarine) and sugar are chosen as the essential foods to be subsidized, and, if it were found that,

say 4s. 6d. a week was the amount available for food among the poorest 10 per cent of the population, the price of these basic foods should be fixed so that a sufficient amount of them can be bought for, say, 3s, leaving 1s. 6d for the purchase of other foods, such as beef, mutton, fish, fruit, and tea and other beverages.

With such a policy it is doubtful whether it would be worth while maintaining a costly and elaborate organization for the detailed control of food The Government is the wholesale purchaser It can fix wholesale prices at a level estimated to have the retail price within the purchasing power of everybody. If the wholesale prices are known and wholesale distribution equitable, competition between merchants and shopkeepers, who are dependent upon the goodwill of their customers, will probably be sufficient to prevent any profiteering Indeed, it has never been suggested that there was any gross profiteering amongst shopkeepers Speculation and profiteering, in so far as it existed at all, was in large wholesale dealing, which is now under Government control.

The policy would provide a flexible system for adjusting the national dietary to what we can afford in money or in shipping space The few essential foods chosen to be subsidized and to be provided in such abundance as there would be no need for rationing, would be regarded as the rock-bottom diet below which we cannot go with safety. Consumption of the other foods could be controlled by price If we wish to economize in shipping and foreign exchange, we can limit consumption by increasing the price On the other hand, if supplies of some other foods were sufficient, they could be added to the list of 'essential' subsidized foods and so brought within the reach of everybody. It is most probable that at the present time some other foods such as cheese and dried fruits could be added to the list. If the Government controls the wholesale trade, which is the bottle neck of our food supply, it can regulate consumption as seems desirable by regulating wholesale prices.

In the same way, home production can be regulated by price The farmer produces for profit He increases or decreases his output of different foods according to the price he thinks he will get. The farmer should be given a guaranteed minimum price calculated to call forth the additional food we need. The guaranteed prices of the different foods should be adjusted to each other in such proportion that the foods would be produced in the proportion we want The control of production by the regulation of the price offered would enable farmers to devote their land to the crops for which they are most suited This would utilize the land of Great Britain to better advantage and give a greater increase in production than a system of compulsory ploughing-up according to a fixed ratio, without any guidance as to what additional foods should be grown.

THE SEVERE WINTER OF 1939-40

THE frost which began on December 27, 1939, and continued with few intermissions until about February 18, 1940, was the most severe in Great Britain since 1895 December 1939 was cold on the whole, the average temperature of 37·8° F at Kew being nearly 4° F below the normal; but apart from a short spell of frost about December 22 it did not approach in severity the latter part of the winter At the end of the month the minimum at Kew fell to 19° F, but comparatively mild conditions returned during the first week in January. The main period of frost came between January 10 and 24, when the mean temperature at Kew was continuously below freezing except for January 12 and fell to 22° F on January 20. Some very low minima were recorded in all parts of England and Scotland: − 5° F. in the screen at Dalwhinnie, − 6° F at Bodiam in south-east England and Ambleside in the north-west, and − 10° F. at Rhayader, all between January 17 and 21. At Greenwich the lowest minimum was 12° F., identical with the lowest minimum there in February 1929 and 5° higher than in February 1895. After a short break the month ended with another cold spell, and the mean temperature at Kew was as low as 31 3° F., compared with a normal of 40·5°. February began cold, but severe weather was not encountered until February 10, when another week of frost began, with very low temperatures about February 14.

There was not a great deal of snow in Britain, except in the north, but an even more disastrous phenomenon, glazed frost, occurred over the South and West of England on January 27–28. All through the Saturday night and most of Sunday, fine rain fell through a layer of air which was just below 32° F. The raindrops were cooled below freezing point, but remained liquid until they struck the ground or exposed objects, when they froze instantly into hard clear ice. Twigs and branches of trees, telephone wires and railway tracks were coated several inches thick; one length of telegraph wire in Gloucestershire carried a cylinder of ice 2·4 in. in diameter, and weighing

130 times as much as the wire alone. Mr. C. J. P. Cave calculated that in Hampshire there was a weight of 85–90 lb. of ice on a single wire between adjacent posts. Under the strain, wires and posts gave way, blocking roads and disorganizing the telephone service. Trees were split or brought down by the weight of ice on their branches, and added to the confusion, while the frozen road and rail surfaces caused an almost complete breakdown of transport. The weather continued very cold, and it was some days before conditions approached normal; there was even a second, though less severe, glazed frost on the morning of February 3.

The difference of eleven years between 1929 and 1940 at once suggests the influence of the sunspot cycle, especially when it is remembered that February 1917 also produced a severe frost, while that of 1895 came 22–23 years earlier. All these occurred about one year after a sunspot maximum. There was, however, no similar frost in 1906 or 1907 and the eleven-year recurrence is completely absent before 1895, so that the succession 1917-1929-1940 must be regarded as most probably a coincidence. D. Brunt, in his study "Periodicities in European Weather" (*Phil. Trans. Roy. Soc., Lond.*, A, 225, 247–302), finds no trace of a periodicity of eleven years in the temperatures of London, Stockholm, Paris or Vienna. The cycle of eleven years is the largest periodic element in the temperature of Edinburgh, and shows a minimum about 1938–39; but the double sunspot cycle of 22–23 years is almost equally prominent and is now near its maximum. For London this 22–23 year cycle is the largest component and is likewise near its maximum. In any event the amplitude of these periodic terms is small in comparison with the departures from normal temperature during a severe winter.

The other well-known cycle, Brückner's of thirty-five years, also fails to appear in Brunt's tables for London and Edinburgh, though he found it at Paris and Berlin. It happens that the interval between the last two great frosts, 1895 and 1929, was thirty-four years, but the Bruckner cycle is of no help on this occasion, for the winter of 1904–5 was not particularly cold. Nor was 1840, in spite of the supposed grand cycle of a hundred years. Cycles are useless for forecasting severe winters.

On the other hand, although really severe winters may come at irregular intervals, they do present a considerable regularity in the course of events which constitutes them. The greatest intensity of cold rarely occurs until some time in January and quite frequently not until February, and in Great Britain it tends to come in waves of ten or fifteen days separated by brief intervals of milder weather. In a prolonged severe winter, central Europe is occupied by a persistent stream of very cold air coming from the east and north-east, with a temperature sometimes many degrees below 0° F., but over the Atlantic the normal south-westerly winds still prevail. For most of the time the cold winds succeed in crossing the North Sea or English Channel, though sometimes by devious routes, but now and again they give place to the mild south-westerlies. Even the brief passage over the North Sea warms the cold air appreciably, and temperatures in Britain do not fall so low as those on the Continent. Minimum temperatures are not yet available; but at 7h., temperatures only a degree or two above 0° F. were recorded at Copenhagen on January 17 and at Paris on January 23–25. Farther east much lower figures were recorded, down to – 26° F. at Dorpat on January 17. The whole period from about January 1 until January 25 appears to have been generally cold in Europe.

Another cold wave began about February 9, and on February 12, when Copenhagen recorded – 4° F. at 7h., the Baltic between Denmark and Sweden was firmly frozen and, according to reports in the Press, was crossed on foot for the first time in centuries.

OBITUARIES

Colonel R. E. B. Crompton, C.B., F.R.S.

WE deeply regret to record the death on February 15 at ninety-four years of age of Colonel R. E. B. Crompton. He was one of the greatest pioneers both in mechanical road traction and in electrical engineering.

Rookes Evelyn Bell Crompton was born at Sion Hill, Yorkshire, on May 31, 1845. In 1871, he married Elizabeth Gertrude, daughter of George Clarke of Tanfield House, Ripon, and had two sons and three daughters. He was educated at Harrow and served as a naval cadet in the Crimean War (medal and Sebastopol clasp); in the Rifle Brigade (1864–76); in South Africa, 1900 (despatches, Queen's medal with three clasps, C.B.). He was founder of Crompton and Co.; twice president of the Institution of Electrical Engineers; president of the Institution of Automobile Engineers; founder member of the Royal Automobile Club.

Colonel Crompton had a most varied and interesting life and career, and had numerous friends all over

the world. Luckily for us, in 1928 he wrote a volume of "Reminiscences" which he dedicated to his wife; "during almost sixty years my courageous fellow-worker and devoted companion". She died on November 27 last, to the great grief of her husband They had nearly reached the seventieth anniversary of their wedding day

The Hon. Sir Arthur Stanley, treasurer of St. Thomas's Hospital, London, in an introduction he wrote to Crompton's "Reminiscences", says: "to write the preface to an autobiography is never a very easy task, but when it is the self-told life story of a man of 83, every minute of which has been made to do the work of two, the task becomes well-nigh impossible" One who remembered Lord Alvanley, the celebrated wit, and could speak of the Great Exhibition in Hyde Park as if it were a thing of yesterday, who was a cadet in the Royal Navy at the age of eleven; who, at that early age, went out and received the Crimean War Medal and Sebastopol clasp before reaching the age of twelve, was undoubtedly making a remarkable beginning to a wonderful career

Then comes a period which is similar to the ordinary life of a lively English boy When Crompton returned to England he left the Navy, and towards the end of 1856 was sent to school at Elstree to prepare for Harrow He left Harrow in 1860 and entered the Rifle Brigade three years later. He went to India in the following year, and after serving for a time with his regiment was seconded for special service as superintendent of the Government Steam Train Department. In 1865, when the summer was exceptionally hot, he caught a particularly noxious form of malaria, which troubled him intermittently for many years He was sent by his doctors to the Murree Hills to convalesce, and made friends with several great sportsmen.

Shortly after this, Crompton received a staff appointment at the Umballa Durbar, and got into touch with several influential men at headquarters. He was invited by the commander-in-chief to the aides-de-camp quarters at Simla, and he was successful in interesting them in his project of substituting mechanical transport for the bullock trains which at that time were generally employed for army purposes. He was appointed an extra aide-de-camp to the commander-in-chief, and in this capacity was often asked to accompany Lord Mayo, the Viceroy, on his rides His own road engine (the *Blue Bell*), which he had practically completed before he left for India and which travelled at an average speed of four miles per hour, had been left in the hands of R. W. Thomson of Edinburgh, to develop. Through the good services of the Director-General of the Post Office, who controlled the bullock train service in India, the first *Blue Bell* 6 h.p. road vehicle was ordered and Crompton received the official appointment as "Superintendent of the Government Steam Train", so as to take charge of the experiments. He was temporarily withdrawn from the army in order that this could be done. After many difficulties and adventures with the *Blue Bell* in India, his return to London was of an unusual kind, as the Franco-Prussian War was on and Paris was invested. Eventually the German military authorities gave them permission to proceed, provided they put on uniforms and wore their swords to show that they were officers

At this time, mechanical road transport in England was limited to the agricultural traction engines, which were allowed, as a favour, to clank along the high roads at the speed of the man who walked in front with a red flag, and even at those low speeds their hauling capacity was very poor. Thomson, by his invention of rubber tyres of great cross-section which flattened themselves under the weight of the engine, at once doubled the hauling power and allowed his engines to be run at speeds up to ten miles an hour whenever the Red Flag Act permitted it.

From 1878 until 1882, Crompton carried on a business as an electrical manufacturer, confining himself to the manufacture of electrical arc plant The firm sold and installed Gramme generators and Bürgin dynamo machines, for the latter of which it acquired the sole right of manufacture. These machines could supply from six to eight arc lamps in series, and so the firm could undertake the lighting of railway stations, goods yards, docks and other open places in which work has to be carried on at night, and for such purposes the firm found a ready market An order to light St. Enoch Station, Glasgow, with arc lamps was obtained, and the interest taken in this work by Sir William Thomson (Lord Kelvin) cemented a friendship between them which was helpful to both.

Willans the engine-builder, about this time (1879–1880), was a frequent visitor at Crompton's house in Porchester Gardens. They were both interested in electrical development and were able to discuss together and help one another in their respective difficulties They agreed that the generator sets of the future must consist of a high-speed engine coupled direct to a direct current dynamo During 1879, Cromptons designed many portable sets of electric lighting plant. Combined with this set, the first Willans high-speed compound engine gave such remarkably economical results that it attracted great attention from the engineering world. About Christmas, 1879, Crompton lighted up his own house in Porchester Gardens. At first he used primary cells, but they were not a success, so he brought in one of his portable sets into the mews at the back of his house and gave special parties, using small arc lights fixed in his drawing-room and dining-room. This was probably the first instance of effective electric lighting in a private house, although there had previously been exhibitions of arc lighting at the Royal Institution and elsewhere.

Early in the year 1880, a messenger from Messrs. Mawson and Swan, the well-known chemists of Newcastle, to whom Crompton had supplied arc lighting plant, called on him to say that Mr. Swan urgently desired to see him. He went to Newcastle, where Swan took him to his laboratory and showed him twenty small incandescent lamps, which burned very

brightly and steadily, each having a carbon filament enclosed in a globe, exhausted to a very perfect vacuum, and claimed that he had solved the problem of electric light for internal illumination. Crompton agreed with him. Later in the same year (1881), the great German physicist Helmholtz lectured at University College, London, and for the illustration of his experimental work Crompton supplied him with one of his portable sets of generating plant. For the International Exposition of Electric Lighting held in Paris in the summer and autumn of 1881 in the Palais de l'Industrie, Cromptons sent over a fine exhibit, and were awarded the first gold medal ever given for electric lighting plant.

The great fire which in 1883 destroyed the Ring Theatre of Vienna with great loss of life so impressed on the Emperor Francis Joseph the dangers of gas that he asked the Imperial and Continental Gas Company, which then supplied gas for the lighting of Vienna, whether it could not arrange for the lighting of the Opera House and the other Imperial theatres by electricity as being a safer and better illuminant The Gas Company, advised by Prof. Monnier of the École Centrale in Paris, suggested that Crompton should be called in for consultation, and so in June 1885 he went with Prof Monnier to Vienna and spent some weeks in considering the Emperor's question At this time a small central station had been started in Berlin in the Friedrichstrasse. In London, the original Edison Company had done the same at a point near the Holborn Viaduct, and the Grosvenor Gallery scheme was in its initial stage At this time the Swan Company had succeeded in turning out satisfactorily 100-volt lamps At Vienna the company designed from its central station in the Schenkenstrasse 440-volt generators and laid twin conductors to carry this pressure up to the Opera House. Babcock and Wilcox boilers were some of those used. Part of the Vienna plant was delivered in the spring of 1886, and when more plant was required, Crompton went to Witcowitz in Moravia to give instructions for the boiler work.

The old Emperor Francis Joseph showed great interest in the electrical work when in progress, and very frequently came to watch the workmen, generally accompanied by his son, the Crown Prince. He paid Crompton the high compliment of saying that he wished his son Rudolph to be a good deal with them as a sort of pupil.

As soon as new scenic effects were made possible by electric lighting, Crompton had to spend a good deal of his time on the stage of the Grand Opera This threw him into the society of Richter, who had already made his name as the great conductor of opera in London and was then endeavouring to reconcile old-time opera with the Wagnerism that was then just commencing. At that time there were two directors of the Grand Opera, Richter, who stood rather for the old school, and Jahn, who was all for Wagner and the Wagner school. They used to have great arguments and ask Crompton for his opinion on musical points. Crompton disclaimed all pretence of being an authority on music, although his mother had known Mendelssohn well at the time of his apogee and was acquainted with very many of the musical world at that time.

In 1896, Dr. John Hopkinson, who had succeeded Colonel Crompton as president of the Institution of Electrical Engineers, discussed the possibility of forming a corps of electrical engineers. This was accepted by the War Office, and Hopkinson took command with the rank of major in the Royal Engineers, Crompton being the senior captain. Four or five men well known in the electrical profession, including Hopkinson's eldest son Bertie, also joined the corps as officers. After training at Alum Bay in the Isle of Wight, Dr Hopkinson left the corps to join his family in Switzerland. But a few weeks later the sad news arrived that he and two members of his family had been killed when climbing on the Alps, and so the whole work of training and organization of the corps fell on Crompton's shoulders.

Throughout the years which followed his return from the Boer War until 1914, Crompton never ceased from his efforts to persuade the War Office to interest itself in the introduction of mechanical transport, not only for war material, but also for the haulage into position of guns of greater power than had been hitherto used.

In an epilogue to his book of reminiscences Crompton says, quoting from an address he delivered to the borough authorities of Chelmsford in 1900, at the time when that town received its first cheap electrical supply:

"England in future, instead of being spoilt by densely populated industrial centres, might be covered with cottages extending for miles over the present almost uninhabited rural districts, so that the population would be more evenly spread over the kingdom. The factory hands, instead of having to work under the shafting in factories, should be able by the electrical transmission of power to carry on industrial pursuits in their own cottage homes That is the future which lies before electrical engineers if they have the pluck and energy to force their views upon the public to a sufficient extent. The thing has been done in Switzerland, in Sweden and elsewhere on the Continent, and if I can live to see it accomplished in our own country, I shall be proud to have contributed in some degree to the solution of all the greatest problems of distribution."

ALEXANDER RUSSELL.

Prof. Ludwig Hopf

THE death of Prof. Ludwig Hopf occurred on December 21 at Dublin, only a few months after he had been appointed lecturer in applied mathematics at Trinity College, Dublin. Dr. Hopf went as a refugee to Cambridge in April 1939, after having lost his position as professor of applied mathematics at the Technische Hochschule, Aachen, on racial grounds soon after the Nazis came into power. He had been on the staff of the Hochschule since 1914 and had become one of its most popular teachers.

As one of the first pupils of Sommerfeld at Munich, Hopf graduated in 1909 with a thesis on the problem of turbulent flow in a river He worked in particular on the influence of the roughness of the walls of a canal on the transition from laminary to turbulent flow. This work brought him into contact with the Mittlere Isar water regulation and drainage scheme, to which he was scientific adviser for several years During the War of 1914-18, Hopf did valuable work on problems of stability of aeroplanes, and his collaboration with R. Fuchs led to their well-known monograph on aerodynamics In the second edition (1934) the book was divided into three volumes, Hopf being responsible for the first, which dealt with general principles This is still being used as the chief text-book for aeroplane designers in Germany.

In the early days of relativity and of quantum theory, Hopf collaborated with Einstein (1910–11) Several papers on radiation dating from that time, and a recent well-written popular account of matter and radiation (Springer, 1936) bear witness to his interest in this subject. More recently, Hopf studied the methods of solving linear differential equations in separate domains with the view of finding the relation between the corresponding solutions. A first paper appeared in 1935, and important applications to physical problems were to follow. The many friends of this genial and kind-hearted mathematician will deeply regret the loss they have suffered.

Prince Ginori-Conti

WHEN Prince Piero Ginori-Conti died on December 9, Italy lost one of her most energetic industrial personalities and international science a devoted supporter. His name will always be associated with the industrial utilization of the volcanic springs in the Lardarello district of Tuscany. Thanks to his 'drive' and business acumen, these waters were made to generate electric current for transmission to Florence and Pisa, and to yield boric acid, carbon dioxide, etc., for industrial use. In the chemical works connected with this great undertaking, he was much helped by Prof R. Nasini, and on the engineering side his son, Dr. Giovanni, one of the three children by his first wife, was of great assistance. An article on the Lardarello development appeared in NATURE of January 14, 1928, p. 59.

Ginori-Conti was born in 1865 as a scion of two ancient Italian families, Ginori and Conti, and on the latter side he claimed relationship with the Scottish Mackenzies. His title of Prince of Trevignano was inherited; that of Senator was granted him later in life. His first wife was the daughter of the Count of Lardarel, the owner of the springs, and his second wife was a French lady. A charming personality, Prince Ginori-Conti came frequently to London where, as a member of the executive committee of the Union Internationale de la Chimie, and as an honorary member of the Society of Chemical Industry, his visits were much appreciated by numerous friends.

Prof. Alexandru Slatineanu

PROF. ALEXANDRU SLATINEANU, a leading Rumanian bacteriologist and hygienist, who died on November 27, 1939, was born at Bucharest on January 5, 1873. He studied medicine in Paris under Berger, Dejerine, Babinski and Metchnikoff, in whose laboratory at the Pasteur Institute he made the acquaintance of his compatriot Prof. Cantacuzène, with whom he was closely associated henceforth. He qualified in 1901 with a thesis on experimental *Bacillus pfeiffer septicæmia*, for which he received the university medal awarded for theses of outstanding merit

From 1902 until 1912, when he was appointed professor of bacteriology at Jassy, Slatineanu acted as chief assistant to Cantacuzène at Bucharest in his work on experimental medicine and the reorganization of the Rumanian health services. At Jassy he founded an institute of hygiene of which he was made director, and also organized an isolation hospital for infectious diseases. In 1917 he took an active part in the campaign against typhus fever which was then very prevalent in Moldavia. In 1931 he was appointed general secretary of the Rumanian Ministry of Health under Prof. Cantacuzène, who was the minister of that office. He was the author of numerous articles on infectious diseases which were published in French in the *Comptes rendus de la Société de Biologie*, *Bulletin de la Société de Pathologie Exotique*, *Archives roumains de Pathologie*, or in Rumanian in the *Revista Stintelor Medicale*.

J. D. ROLLESTON.

Dr. E. M. Mikkola

DR ERKKI MIKAEL MIKKOLA, geologist of the Geological Commission of Finland, was killed at Taipale on February 13. Mikkola, who was born in 1907, had become a leading authority in Pre-Cambrian geology, possessing an intuitive faculty of seeing through a geological formation, and picturing it correctly in space and time. His scientific studies led him from botany to geography, quaternary geology, tectonics and petrology. His three Lapland maps are given a foremost place among Pre-Cambrian sheets of the Finnish Geological Survey. Their description in Engl sh is a monograph of fundamental value.

When the Russian attack developed on November 30, Mikkola, as a lieutenant in the reserve, went to join his company, leaving the Geological Survey at Helsinki just one hour before it was destroyed during a bombing raid. Thereafter he spent all his time, two and a half months, in the front lines, taking a full share in the dangers of the heroic defence.

WE regret to announce the following deaths:

Prof. C. D. Marx, emeritus professor of civil engineering in Stanford University, on December 31, aged eighty-two years.

Mr. H. C. Newton, first chairman of Messrs. Newton and Wright, Ltd., London, manufacturers of X-ray equipment, on February 19, aged eighty years.

NEWS AND VIEWS

Lord Halifax and International Affairs

MANY speeches dealing with the present crisis have been made since the War began six months ago That of Lord Halifax at Oxford on February 27 surpassed them all not only in the clarity with which the fundamental issues at stake were set forth, but also in the eloquent and moving enunciation of their relation to a philosophy of life which looks beyond the individual ideal to an aim worthy of the pursuit of mankind at large. Addressing his audience, as he said, with the dual personality of Chancellor of the University and H M Secretary of State for Foreign Affairs, Lord Halifax made no attempt to gloss over the facts, unpleasing as they may be, or to ignore the grave dangers for the future of civilization which they imply. The one fact by which above all he is appalled is that this "waste land" we live in, as the present state of European civilization has been called, has been brought about not by the mistakes, the pride, and the selfishness of an older generation, but by that of youth, deprived of the elements of true judgment, which has been the driving force behind the Nazi movement. But, if on one side force is an instrument of aggression, on the other, youth will fight to break down the barrier which must be broken down, if the youth of Europe is to avoid living always in this "waste land".

The antagonisms which have brought about the present conflict in Europe are by now familiar in terms to all; but as formulated by Lord Halifax before an audience composed largely of those whose task will be to ensure that right prevails, they are seen to penetrate to the very fundamentals of human associations. On one side is an all-embracing and overpowering system—a system based on the conception of the so-called economic man—and over against it the ideal which has made as its end the perfection of the individual "in the conviction that here, too, lay the secret of life for all society". It must be remembered that "the substance of any conventional code . . . must derive from the depreciation by society of the principles of its own survival" and, he went on to say, "If we are to recapture the secret of order for international society . . . we must as individuals strive to erect or maintain standards that will bring true freedom through the way of discipline". If any good thing can come out of so great an evil, it is that the outbreak of War has constrained the British peoples to reason with themselves upon the nature and aims of the societies in which they live. If there still be those in whose minds there lingers a doubt, they cannot fail now to see the issues clearly in the light of what Lord Halifax has said

Universities in War-time

DR. RAYMOND PRIESTLEY, vice-chancellor of the University of Birmingham, devoted his address at the annual meeting of the Court of Governors of the University to a discussion of war conditions. He said that the university, until now, has fared very well Numbers are almost up to normal and on the science and applied science side the great majority of students will remain until they have graduated "Reservation is not intended to prevent, and will not prevent, university-trained youth from playing its part in the country's war effort. Their advent is merely deferred until they are fully prepared to pull their weight." In this way fully trained men will become available at the end of each academic year, and there will be a proportion able to play their part in the reconstruction that must follow the end of the War if European civilization is to make up leeway and resume its advance. Dr. Priestley went on to say that he believed it is not necessarily bad for young university men to pass through the Army, the Navy, or the Air Force on the way to their normal work in the world. He quoted his own experience of the War of 1914–18: "I came out of it a better man—more humane and better able to deal with situations and with men". When the War ends, the universities and university men will have a more important part to play even than in war-time, and it would be fatal if a false impression got abroad that university personnel claims to be set apart from the generality of citizens.

The recognition by the Government that the work of the universities of Great Britain is part of the national cause in the War has provoked criticism Dr. Priestley believes this to be unfair. Indeed, he thinks that there can never have been an occasion when, in similar circumstances of national strain, a Government has been more far-sighted in this particular respect. In the War of 1914–18, education almost closed down. By the decision to refrain from enlisting the youth of the nation before the age of twenty, the Government has given technical and university education a chance to continue their task For this purpose the universities require adequate finance. "They provide the technical experts on whom the servicing of the post-War world will depend. They provide the teachers who must tune to concert pitch the bodies and minds of succeeding generations. They ought to produce a large proportion of the enlightened leaders for the new era. Certainly if they do not, leadership, though it may be powerful, will not be enlightened." He also referred to the universities as "the chief repositories, exponents, and defenders of that freedom of thought that has been quenched in the totalitarian State".

Evacuation of Schoolchildren

THE Government Evacuation Scheme is reviewed in a Circular (No. 1965) to county councils and local authorities and an accompanying memorandum (Memo. Ev. 8 (London H.M Stationery Office. 4*d*. net)), which explain in detail the scheme recently announced by the President of the Board of Education More than 400,000 evacuated schoolchildren remain in the reception areas, and the Government is of the opinion that dispersal of children from the evacuating areas is as desirable now as it was at the outbreak of the War. The first objective of policy is therefore to ensure that there is no further drift back of those children to the evacuation areas To secure an equitable distribution of the burden of private billeting, householders in reception areas are to be invited to place their names on a roll, one of the primary objects of which will be to secure a list of persons willing to share with their neighbours in the care of children who have been billeted since the outbreak of war Local authorities also have compulsory powers if the voluntary response is insufficient. At the same time, the billeting allowance has been increased to 10*s*. 6*d* a week for all schoolchildren of fourteen years and over as from March 2.

The further plans to be made for evacuation are for schoolchildren only, and will only be operated if air raids develop on a scale involving serious and continuing perils to civilian population. Evacuation will remain on a voluntary basis, but parents registering their children will be asked to sign undertakings that they will send them with the school party if evacuation is ordered and that they intend to leave them in the reception area until the party returns. The areas to be evacuated will be the same as those evacuated in September 1939, but the decision to evacuate any area will be taken in the light of prevailing conditions Not less than 36 hours notice will be given to any particular area, and specified parties will be taken as far as possible to specified destinations. Children found to be suffering from infection or disease or serious uncleanliness are not to be billeted on householders in that condition. While the fullest possible use is to be made of the camps provided by the Government, the contribution from this source is limited. To supplement this, each receiving authority is being asked to provide hostels available for about 5 per cent of the children to be received, utilizing for this purpose a certain number of empty houses

Institute of Chemistry

IN submitting the annual report of the Council at the sixty-second annual general meeting of the Institute of Chemistry, Sir Robert Pickard, senior vice-president, who presided, owing to the death of the president, Mr. W. A. S. Calder, early in January, said that the Institute, as the professional organization of chemists, has assisted the Government in supplying its needs in technical personnel for industries essential in war-time. The roll of the Institute continues to increase and now numbers more than 7,550, more than five times as many members as were registered in 1914. Those who could remember the position forty years ago, and recall the difficulty at that time of making any headway in the profession of chemistry, have watched the astonishing increase in the number of chemists, their growing influence, the increasing applications of science and the steady absorption of chemical talent in industry and commerce, in Government and municipal service, and in the affairs of everyday life. The profession of chemistry now stands high in the public esteem as a very essential service

The report of the honorary treasurer of the Institute shows that the Institute is financially in a sound condition. Referring to the burden of publication expenses, he expressed the hope that the fund which had been raised by the Chemical Council, from industry as well as from chemists themselves, will help to put the affairs of the publishing societies—the Chemical Society and the Society of Chemical Industry—on a sounder financial basis The officers and council for the ensuing session were elected, the new president being Dr. J. J. Fox, Government Chemist.

Relics of Ancient Egyptian Royalty

THE black granite sarcophagus of Pharaoh Psusennes, discovered at San el Hagar, the ancient Tanis, by Prof Montet of the University of Strasbourg (see NATURE, February 24, p 300), was opened in the presence of King Farouk on February 28. Inside, it is reported (*The Times*, February 29), was a silver sarcophagus, about 7 ft. long, in the likeness of King Psusennes On the head were the royal insignia, and in the hands, which were folded across the chest, were a sceptre and a flail. The state of preservation and the exquisite carving are said to combine in making this one of the most beautiful objects discovered in recent years. The silver sarcophagus was in two pieces. Inside it was another sarcophagus, of which the top was a silver-gilt body-covering and a gold mask, also a likeness of the king. On the chest are long inscriptions, apparently religious texts The lower half of the coffin had been of some metal, which had completely disappeared owing to the damp that had seeped in between cracks. In consequence, the mummy also had disappeared, only a mass of mud being left, in which were a few bones.

On the removal of the sarcophagi, a mass of fine jewellery was found in the granite case. Twenty-one gold bracelets, ten from the right arm and eleven from the left arm of Psusennes, all bear inscriptions which trace the king's genealogical tree and give details which will be of importance for the history of a period obscure in its dynastic relationships. Inscriptions giving the names of the king's mother and uncles, pointing to a possible connexion with Thebes, have already been deciphered Many gold necklaces, some adorned with rubies and scarabs, were found, as well as finger and toe cases of gold. Photographs of the site, sarcophagi, and some of the finds appeared in *The Times* of February 29.

University of Birmingham

AT the annual meeting of the Court of Governors, the Pro-Chancellor, Mr. E. P. Beale, welcomed, with relief, the announcement that the Treasury grant to the universities is not to be reduced. He also announced with gratification that contributions from the Birmingham City Council and the surrounding local authorities showed a substantial increase, due mainly to the grant of an additional £750 from the Warwickshire County Council. He regretted that it had been necessary, owing to lack of financial support, to close the Department of Industrial Hygiene and Medicine; he hoped the setback would be only temporary. He also referred to the endowment of a chair of theology by Dr Edward Cadbury The endowment fund (£32,000) is the largest individual benefaction received by the University in 1939

The Nuffield Physics Laboratory is now occupied. The magnet of the large cyclotron has been erected free of charge by Messrs Horsley Bridge and Thomas Piggott, Ltd., of Tipton, the steel for its construction having been supplied on most generous terms by Messrs. Colvilles, Ltd., of Glasgow Prof. S. Zuckerman, who was appointed to the chair of anatomy to succeed Prof. R D. Lockhart, is engaged on work of national importance and it has been agreed that, in consequence, he shall postpone taking up duty at Birmingham. Dr. C. F. V Smout is continuing to act as temporary head of the department

Higher Education in Palestine

THE Friends of the Hebrew University of Jerusalem have just published their annual report, 1938–39 (199 Piccadilly, London). This University is an important centre of culture in a distracted country and continues, we are glad to see, constructive effort, though faced with financial uncertainty. A new Medical Centre was opened last year, including a fine hospital with three hundred beds and first-rate equipment. For the present it will be mainly devoted to medical research and post-graduate courses. Progress has been made with agriculture and education, for which eight diplomas were awarded last year. The University is enterprising enough to broadcast popular talks on its work, and its friends are busy in Great Britain seeking to make up for losses due to the War It is hoped that some special donations may help a large number of students who, coming from countries under German domination, can no longer receive the money on which they formerly relied. It is estimated that £6,000 will be needed for urgent cases.

The Hebrew Technical Institute, Haifa, has altogether more than seven hundred students and a staff augmented by some distinguished refugees. A Nautical School was started in 1938 and has its own training ship. The Daniel Sieff Research Institute has been experimenting, for the benefit of the orange industry, on peels and other waste products. Difficulties of transport will keep much of the present crop at home. Johnson used orange peel for indigestion, but it is scarcely likely to survive to-day as a remedy.

The Blind Spot

HELMHOLTZ, in his "Handbuch der physiologischen Optik" (1867), stated that the demonstration of the blind spot of the eye, the discovery of which was communicated by the Abbé Edme Mariotte to the Royal Academy of Sciences in France in the winter of 1667–68, was given before the King of England in 1668. Dr J. Bröns, of Copenhagen, in a monograph on "The Blind Spot of Mariotte" (London H. K. Lewis and Co, Ltd, 1939. 12*s* net), proves that this statement is erroneous, and brings forward strong evidence of the manner in which it arose. In 1776, Georg Simon Klugel, professor of mathematics in the University of Helmstädt, published a translation of Joseph Priestley's "The History and present state of Discoveries relating to Vision, Light and Colours" (London, 1772). On p. 144 of the translation there is a footnote as follows: "(a) Smith's Opticks, Remarks, p. 6 (d d Ausg S. 367) Oeuvres de Mariotte, p. 496. (Der Versuch ist 1668 vor dem Könige von England gemacht. Birch, T. 2, p. 281 Haller's Phys, T 5, p 470, K.)" The reference to Birch shows that the communication to the Royal Society was made by Oldenburg, and not by Mariotte, and there is good evidence that the king was not present at that, or indeed any other, meeting The reference to Albrecht von Haller, also a footnote, is in his "Elementa physiolgiæ corporis humani" (Lausanæ, 1763), also contained in his "Anfangsgründe der Physiologie", S, p 470, Berlin-Leipzig, 1772. This reads as follows: "Factum ann 1668 coram S. Reg Maj T. Birch, T II, p 281 Exstat oper Mariot, p 496, Ed Holl". Dr. Brons thinks that Klügel expanded the footnote to "Factum anno 1668 coram *Sua* Regia Majestate", adding his translation "Der Versuch ist 1668 vor dem Konige von England gemacht", whereas it should read "Factum anno 1668 coram *Societate* Regiæ Majestatis"—"the experiment was shown before the Royal Society".

Progress at the British Museum

IT is strange to read in the recently published annual report of the British Museum of events like the special Thomas Cromwell exhibition and, in the Natural History Museum, the retirement of Dr. Tate Regan and succession of Dr. C. Foster-Cooper, which seem to be matters of ancient history, but perhaps that is inevitable when H.M. Stationery Office issues the Museum's Annual Report for 1938 at the end of 1939. The interest of the public in museums has been undoubtedly on the up-grade in recent years, and this is reflected in an increased attendance (7,720) at the Natural History Museum. It is more difficult to account for the serious fall of more than 80,000 in the number of visitors at the British Museum, where the total, still exceeding one million, was the lowest since 1926. Perhaps the decrease was a reflection of the international disturbances in the autumn of 1938, for the work involved in air raid precautions, in training the staff in anti-gas measures, and planning for the safety of the invaluable contents of these institutions obviously interfered with normal working in the departments. Yet in these museums

good progress was made, both in the development of the exhibited collections and in the less spectacular research conducted in the laboratories. That this work should now have been brought almost to a stop is regrettable, if inevitable The announcement recently made that certain galleries are to be reopened to the public, and that special exhibits of current interest are being arranged, will be widely welcomed.

Biology in Schools

THE latest report of the Joint Committee of the Four Secondary Associations shows useful and, indeed, necessary work for education in the way of criticism, protest and suggestion. Complacency about the success of evacuation is now being reduced Authorities who commandeer schools for officials and leave school buildings in a defective state have much to answer for. Such unwise economy is strange, after reckless expenditure elsewhere A subsidiary subject syllabus is printed which a sub-committee of biologists has suggested for a London Higher School Certificate, since separate syllabuses for botany and zoology are regarded as unsatisfactory This scheme for biology includes six important subjects, from histology to heredity and ecology, though the last-named is reduced to the study of fauna and flora in a restricted area. A practical examination and a written paper, each for three hours, are proposed, but the former, if ill-done, will not mean failure in the subject as a whole. The wide ground is well covered but, as the average teaching time for the whole of the syllabus, including practical work, is three hours a week, is there not too much to get through ? Ambitious programmes tend to produce shallow knowledge which is soon lost.

Cave Man in Colorado

EXCAVATION of a cave near Durango, Colorado, it is anticipated, may afford evidence for an approximate early dating of basket-maker culture in the southwestern States. The investigation was carried out on behalf of the Carnegie Institution of Washington by Earl H. Morris Evidence of occupation, according to a report circulated by Science Service of Washington, D.C., was found below three feet of accumulated debris. There were indications that the inhabitants had lived in one-room structures, with mud-coated floors and fire-pits, though how these constructions were built was not detected. Corn and pumpkins were grown, but the principal mode of subsistence apparently was by hunting.

The most significant find, however, consisted of charcoal, from which tree-ring sequences have been constructed each covering a period of at least one hundred years. These are not only independent of one another, but also of any known Indian tree-ring datings. As those last have now been carried back to about A.D 150, unless, as Dr. A. V. Kidder has suggested, conditions in this area were entirely different from the normal for northern Colorado, this constitutes valid evidence for Basket-maker occupation of the cave at not less than approximately two thousand years ago.

A Preparation for the Control of Bleeding

A FAT-SOLUBLE vitamin, known as vitamin K, is indirectly concerned with blood coagulation, will reduce the clotting time of blood in cases of prothrombin deficiency, and will check certain forms of hæmorrhage, such as occur in obstructive jaundice and occasionally in new-born babies. Vitamin K is found naturally in alfalfa and hog's liver fat, it has been isolated and its chemical composition determined. Several related but simpler compounds are known possessing a physiological action similar to the natural vitamin K, and one of these—a methylnaphthaquinone—has been introduced for use in medicine by Glaxo Laboratories, Ltd., Greenford, Middlesex, under the name "Kapilon". Kapilon has been found to be a valuable agent for reducing bleeding in obstructive jaundice and in neo-natal hæmorrhage

Institution of Electrical Engineers: Scholarships

THE following scholarships are open for award by the Institution of Electrical Engineers during 1940: *Duddell Scholarship* (value £150 per annum, tenable for three years), open to British subjects less than nineteen years of age on July 1, for a whole-time day course in electrical engineering; *Ferranti Scholarship* (value £250 per annum, tenable for two years), open to British subjects less than twenty-six years of age on July 1, who are students or graduates of the Institution, for whole-time research or post-graduate work of an electrical engineering nature; *Swan Memorial Scholarship* (value £120, for one year), open to British subjects less than twenty-seven years of age on July 1, for whole-time research or post-graduate work of an electrical engineering nature; *Silvanus Thompson Scholarship* (value £100 per annum and tuition fees, tenable for two years), for works' employees who are the sons of parents of limited means, open to British subjects less than twenty-two years of age on July 1, for a whole-time day course in electrical engineering at an approved university or technical college; *William Beedie Esson Scholarship* (value £120 per annum, tenable for two years, renewable in approved cases for a third year), for works' employees who are the sons of parents of limited means, open to British subjects less than twenty-two years of age on July 1, for a whole-time day course in electrical engineering at an approved university or technical college. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Royal Society of Edinburgh: New Fellows

THE following have been elected fellows of the Royal Society of Edinburgh: Mr. E. B. Ball, president of the Institution of Mechanical Engineers; Mr. J. Bowman, City water engineer, Edinburgh; Mr. B. S. Bramwell, advocate, London; Mr. J. Brough, lecturer in vertebrate zoology, University of Edinburgh; Dr. A. F. Buchan, teacher of mathematics, James Gillespie's School, Edinburgh; Mr. J. M. Caie, deputy secretary, Department of Agriculture for

Scotland; Mr. J. Cameron, formerly head of the Pharmaceutical Department, Peiping Union Medical College; Prof. J. W. Cook, Department of Chemistry, University of Glasgow; Dr. J. Coutts, lecturer in pharmaceutics and demonstrator in practical pharmacy, St. Bartholomew's Hospital Medical College, London; Mr. Satchidinanda Datta, veterinary research officer, Imperial Veterinary Research Institute, Calcutta; Dr. T. Elder Dickson, art master, George Watson's Ladies College, Edinburgh; Dr. A. T. J. Dollar, assistant in the Department of Geology, University of Glasgow; Dr. H. I. Drever, assistant in the Department of Geology, University of St. Andrews; Mr. W. McC. Harrowes, medical director, New Saughton Hall Private Mental Hospital, Polton, Midlothian; Mr. T. Hart, collector of the Trades House of Glasgow, Prof. C. F. W. Illingworth, Department of Surgery, University of Glasgow, Mr. J. G. Kyd, registrar-general for Scotland, Mr. P. R. Laird, secretary to Department of Agriculture for Scotland; Dr. Robert McAdam, lecturer in mining and surveying, Heriot-Watt College, Edinburgh; Dr. J. A. Macdonald, lecturer in botany, University of St. Andrews; Dr. A. E. W. McLachlan, clinical medical officer, Newcastle General Hospital, Newcastle-upon-Tyne; Dr. A MacNiven, physician superintendent, Royal Mental Hospital, Glasgow; Prof. G. F. Marrian, Department of Chemistry in relation to Medicine, University of Edinburgh; Dr. E. R. A. Merewether, H.M. medical inspector of factories, Birmingham; Mr. R. M. Neill, senior lecturer in zoology, University of Aberdeen; Dr. H. B. Nisbet, lecturer in chemistry, Heriot-Watt College, Edinburgh; Mr. J. S. C. Reid, solicitor-general for Scotland; Mr. H. Riley, founder and headmaster of Strathallan School, Forgandenny, Perthshire; Mr. J. Thomson, distiller, London; Dr. H. M. Traquair, president of the Royal College of Surgeons of Edinburgh, lecturer on diseases of the eye, University of Edinburgh.

Announcements

The council of the Royal Society of Edinburgh has awarded the Keith Prize for the period 1937–39 to Prof. F. A. E. Crew, for his papers and joint papers in the *Proceedings* of the Society within the period of the award, and in recognition of his valuable contributions to animal genetics; and the Neill Prize to Mr. James Wright, for his important paper on "The Scottish Carboniferous Crinoidea", published in the *Transactions* of the Society within the period of the award.

The Senatus of the University of Edinburgh has awarded the Cameron Prize to Prof. E. C. Dodds, Courtauld professor of biochemistry in the University of London, for his work on synthetic œstrogens.

The Masters Memorial Lectures of the Royal Horticultural Society will be delivered in the lecture room of the Society's New Hall in Greycoat Street, Westminster, on April 2 and 16, at 3 p.m., by Prof. F. E. Weiss, on "Graft Hybrids and Chimaeras".

Prof. Max Born, Tait professor of natural philosophy in the University of Edinburgh, will give the distinguished visitor's address before the Royal College of Science Mathematical and Physical Society at the College on March 11 at 5.15. Prof. Born's address will be entitled "On Melting".

Mr. T. T. Paterson, curator of the University Museum of Archæology and Ethnology, Cambridge, will deliver the Swiney lectures on geology in the rooms of the Linnean Society on Fridays and Mondays, at 3 p.m., from March 29 until May 10 (April 19 excepted). The subject of the lectures, to which admission is free, will be "Geology and Early Man".

The Committee on the Chemistry of Proteins of the Division of Chemistry and Chemical Technology of the National Research Council has been granted 3,600 dollars by Mr. Eli Lilly of Indianapolis, for the establishment of a National Research Council fellowship in protein chemistry The fellowship has been awarded to Dr. I Fankuchen, who will carry on X-ray research on proteins in the laboratory of Prof. B E. Warren at the Massachusetts Institute of Technology.

The twelfth International Congress of Psychology, which was planned to take place at Edinburgh in July 1940, has been postponed, though not abandoned. The invitation of the City and University of Edinburgh is not withdrawn, and the Local Organization Committee hopes that the Congress may still meet in Edinburgh when circumstances permit the continuation and completion of the preparations.

The annual meeting of the Swiss Society of Internal Medicine will be held in Bern during May 18-19, when the following subjects will be discussed: the chemistry of vitamins and some enzymes, introduced by Prof. P. Karrer of Zurich; the hypovitaminoses in medical practice, introduced by Prof. Bickel of Geneva. Further information can be obtained from the president, Dr. Otto Roth, Kantonspital, Winterthur.

An Argentine Society of Social Medicine has recently been founded at Buenos Aires.

A monument has been erected at Chateauroux, France, of Stanislas Limousine, the chemist, who invented wafers for unpleasant drugs and pipettes for counting drops, introduced coloured bottles for poisons, organized the first public laboratory, and first injected quinine hypodermically.

According to an investigation carried out in Calcutta, more than 96 per cent of 887 maternal deaths were due to an avoidable factor. Puerperal sepsis accounted for 32 per cent, eclampsia for 18 per cent, hæmorrhage for 11 per cent, anæmia for 24 per cent, and septic abortion for 5 per cent. The chief cause of death from diseases associated with child-bearing was pulmonary tuberculosis, which accounted for 40 per cent.

LETTERS TO THE EDITORS

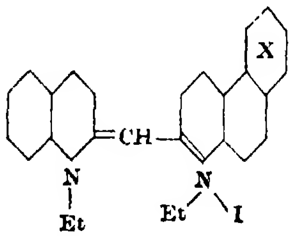
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

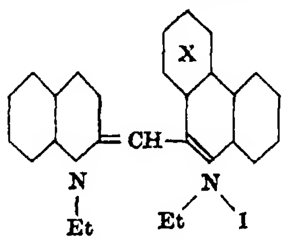
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 391 CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Steric Influence in Optically Sensitizing Dyes

IN a paper by L. G. S. Brooker and C. H. Keyes[1], the preparation is described of certain isomeric cyanine dyes having the following formulæ:



A



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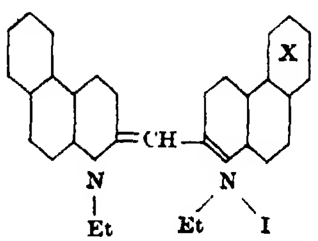

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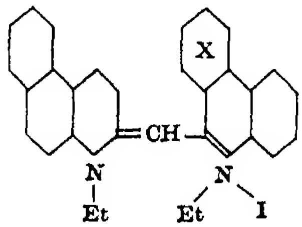

D

Brooker and Keyes noted that dyes *A* and *C* were strong sensitizers, while *B* and *D* did not sensitize. These substances were investigated later by J. A. Leermakers, B. H. Carroll and C. J. Staud[2], who confirmed the sensitizing results. But in addition they observed strong adsorption to gelatino-silver bromide grains of *all* the isomers, and "pronounced absorption maxima (by reflection)".

In recent work on these compounds we have observed, first, that the *rate* of adsorption to silver bromide from aqueous gelatin solution of dyes *B* and *D* is very much lower than for dyes *A* and *C*, although much the same adsorption densities (in molecules per unit area) were ultimately obtained. While this might account to some extent for lack of sensitizing (because of insufficient time of treatment), it does not appear an entirely sufficient explanation. A further complication was encountered in the form of a strong tendency of isomers *B* and *D* to bleach or fade, even in alcoholic solutions, probably by autoxidation.

On constructing the formulæ for these isomers, using correct bond angles and interatomic distances, it can be seen that complete coplanarity of the molecule is not possible in case *B* without bringing the 3,4-benzo-radicle within a distance of *ca.* 1·7 A. of the opposite quinoline group, and in case *D*, of the opposite β-naphtho-quinoline. This condition is not improved by 180° rotation of a nuclear group about a =CH–CH< linkage to an alternate coplanar stereoisomer. The same condition obtains for 1,1'-diethyl-3',4'-dibenzo-2,2'-carbocyanineiodide (having three methines between two phenanthridine nuclei), which was found also not to sensitize, but does not for 1,1'-diethyl-5,6,5',6'-dibenzo-2,2'-carbocyanine iodide (having three methines between two β-naphtho-quinoline nuclei), which sensitizes strongly, and also not for 1,1'-diethyl 3,4,5',6' dibenzo-2,2' carbocyanine iodide (having three methine groups between one β-naphtho-quinoline and one phenanthridine nucleus), and which definitely sensitizes.

On examining the absorption spectra (in alcoholic solution) of the non-coplanar isomers, it was observed that the half-width of the absorption band of maximum wave-length was much greater for the non-coplanar isomers than for their isomers, and the molecular extinction coefficients at $\lambda_{max.}$ were much less. There is also evidence that the yields are considerably lower than in synthesis of similar dyes which can readily assume a coplanar form of the fully extended (*trans-trans*) molecule.

It was suggested by Leermakers, Carroll and Staud[2] that "the phenyl group (*X*) in dyes *B* and *D* interferes with the proper exchange of energy between dye and silver halide, because of some steric effect in the molecule". The steric effect we believe to be the inhibition of coplanarity (cf. for analogous cases C. J. B. Clewes and K. Lonsdale[3], also J. M. Robertson[4]) of the dye molecule, and consequent interference with its resonance. In a fuller account the relation of coplanarity to adsorption (cf. Sheppard, Lambert and Walker)[5] will be discussed, as well as the temperature influence. The steric factor here indicated is of far-reaching importance in regard to the effects of substituents in the polymethine dyes.

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Feb. 2.

[1] *J. Amer. Chem. Soc.*, **58**, 659 (1936).
[2] *J. Chem. Phys.*, **5**, 878 (1937).
[3] *Proc. Roy. Soc.*, A, **161**, 493 (1937).
[4] *J. Chem. Soc.*, 232 (February 1939).
[5] *J. Chem. Phys.*, **7**, 256 (1939).

Gattermann Synthesis of Aldehydes

THE observation was made recently that hydrogen cyanide promotes the growth of certain fungi[1], which indicates the increased activity of the enzymes present in such circumstances. Earlier findings, on the other hand, had had some bearing on the mechanism of the mixed Cannizzaro reaction[2]. Investigations are now being carried out in this laboratory, in an attempt to contribute toward the elucidation of the mechanism of the Gattermann synthesis of aldehydes[3].

These experiments involve an adaptation of the original technique, using aluminium chloride, sodium cyanide (both chemically pure and "Aero Brand"), a solvent belonging to one of several series of hydrocarbons, and dry hydrogen chloride. They have already proved the practicability of this method[4]. The yields thus far obtained are evidenced by some data presented in the table below.

At the same time, the use of solvents belonging to homologous series has already outlined the basis of a rule relating the position of a given solvent in such a series to the yields obtained The table, illustrating the results of an average series of trials, will serve to exemplify the latter point :

Formula of solvent	Name	C-atoms in side chain	Average yield %
PhH	Benzene	0	11
$PhCH_3$	Toluene	1	20
$PhCH_2CH_3$	Ethylbenzene	2	38
$PhCH(CH_3)_2$	Cumene	3	24
$PhCH(CH_3)(C_2H_5)$	sec -Butylbenzene	4	3 5
$PhC(CH_3)_2(C_2H_5)$	tert -Amylbenzene	5	7 5

Further investigations are in progress along several lines (including the influence of directive substituents), with a view toward clarifying some of the less evident features of the Gattermann synthesis.

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New York.
Dec. 26.

[1] Dammann, E , Rotini, O T , and Nord, F F , *Biochem Z* , **297** 192 (1938) *Ergebn Enzymforschg* , **8**, 179 (1939)

[2] Nord, F F., *Beiträge z. Physiol* , **2**, 301 (1924) , *Chem Rev* , **3**, 65 (1926).

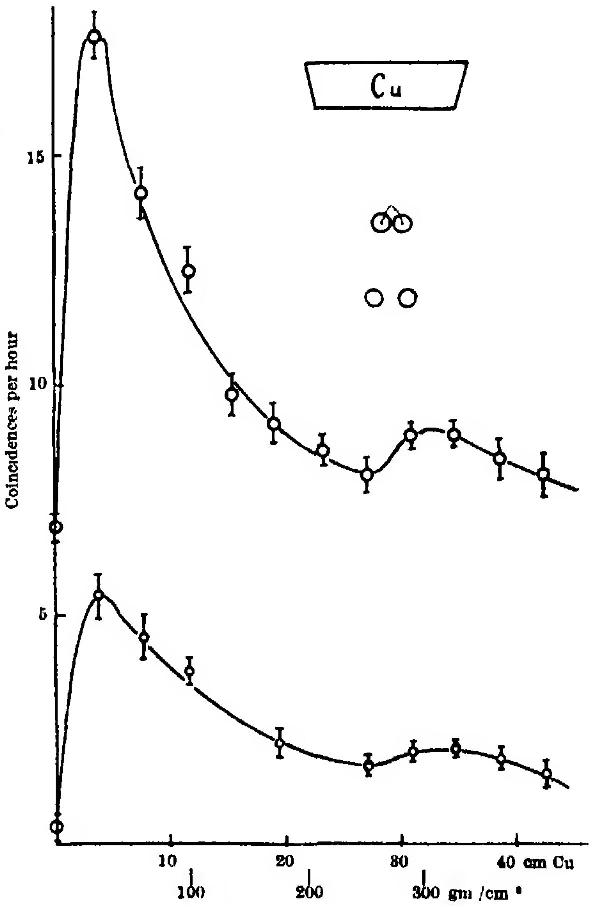
[3] Gattermann, L , *Ber deut chem Ges.*, **31**, 1149 (1898).

[4] cf., however, Montgomery, E., and Adams, R , *J. Amer. Chem Soc* , **46**, 1518 (1924)

The Second Maximum in the Rossi Transition Curve for Copper

K. SCHMEISER and W. BOTHE found a pronounced second maximum in the transition curve for cosmic ray secondaries from large thicknesses of lead. This maximum became the more pronounced the smaller the angle subtended by the counters at the absorber. W. Morgan and K. Nielson, on the other hand, found no indications of a second maximum for a counter arrangement similar to that employed by Schmeiser and Bothe, with the exception that the two upper counters were not joined together, while a rather similar curve to that of Schmeiser and Bothe was obtained when the upper counters were linked together. In this case the background rate was very much increased. This appears to show that the relatively high count under large thicknesses is connected with a high background rate.

In view of the fact that these two experiments are not in harmony, it was considered worth while to investigate the small-angle showers under large thicknesses of material, both when the upper counters are joined and when they count separately. The absorber used was copper, the angle subtended by the counter system at the absorber 6° The curves obtained in the two cases are shown in the accompanying graph. When the upper counters were connected the background rate was certainly increased very much, but the characteristics of the curves remained essentially the same at large thicknesses. Both show a marked second maximum



In the case where the upper counters work separately, and fourfold coincidences are counted, the number of counts without copper is very small, that is, the background rate is very small. Threefold coincidences, with the upper counters joined, show, on the other hand, a large background rate. The conclusion is that it is not the background rate which is responsible for the relatively high count at large thicknesses, but the secondaries from the material placed above the counters.

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Jan. 6.

Electronic Specific Heat of Graphite

IN a previous communication[1] it was shown that the observed large diamagnetism of graphite along its hexagonal axis is that of its 'free' electrons, and is of the Landau type. At high temperatures it conforms to the Curie law $K = -n\mu^2/(3\ kT)$, and at low temperatures it tends to the temperature-independent value $K = -n\mu^2/(2\ kT_0)$, where n, the number of free electrons, is found to be just one per carbon atom, and T_0, the degeneracy temperature, is found to be about 520° K ; μ is the Bohr magneton.

These results fit well with the known electronic structure of graphite. From structural considerations we should expect one electron per carbon atom to be free, and its freedom of movement to be confined to the basal plane. This restriction of the freedom to the basal plane, besides directing the whole of the diamagnetism of these electrons along the normal to the plane, will also make the spacing of the energy levels of these electrons very narrow, and the degeneracy temperature very low, as required by observation.

This number of free electrons, namely, one per atom, together with the very low degeneracy temperature of the electron gas, should make the electronic specific heat of graphite at room temperature, and at low temperatures, much larger than that of most metals. Now the electronic contribution is most easily evaluated at very low temperatures, where the contribution from the lattice becomes relatively small. The available experimental data[2] for graphite extend down to about 29° K only, and from these data the electronic part of the specific heat at low temperatures may be estimated roughly as 20×10^{-4} T cal deg.$^{-1}$ per gm atom. This is more than ten times the electronic specific heat of copper or silver, and is of nearly the same magnitude as that of the transition metals, nickel, platinum and palladium.

It appears that even at 40° K the electronic contribution to the specific heat of graphite greatly predominates over the contribution from the lattice.

K. S. KRISHNAN.

Indian Association for the
Cultivation of Science,
Calcutta. Feb. 9.

[1] NATURE, **145**, 31 (1940); see also presidential address to the Physics Section, Ind. Sci. Congress, Madras Session, 1940.

[2] Nernst, W., *Ann. Phys.*, **36**, 395 (1911); Magnus, A., *Ann. Phys.*, **303**, 70 (1923).

Effect of Synthetic Vitamin B_6 on the Hæmopoietic System of Human Beings

SINCE vitamin B_6 (2-methyl, 3-hydroxy, 4,5-di-[hydroxymethyl] pyridine) is a constituent of liver and yeast, both of which relieve some of the symptoms of pellagra and pernicious anæmia in relapse, it was decided to give large amounts of this synthetic vitamin to pellagrins with macrocytic anæmia and to patients with classical pernicious anæmia. The observations of Fouts, Helmer, Lepkovsky and Jukes[1] show that dogs with a deficiency of vitamin B_6 in the diet develop a hypochromic anæmia which is not relieved by iron. These results have been confirmed and extended by McKibbon, Madden, Black and Elvehjem[2] in puppies. We have searched in vain to date for patients with hypochromic anæmia which did not respond to large amounts of iron. The vitamin B_6 used throughout this study was furnished by Merck and Company, Rahway, New Jersey.

The present report is concerned with the effect of the intravenous administration of from 50 to 100 milligrams of crystalline vitamin B_6 in sterile physiological solution of sodium chloride, each day for a period of ten days, to three pellagrins with macrocytic anæmia and to two patients with pernicious anæmia. Within forty-eight hours, the patients with pellagra and pernicious anæmia experienced considerable increase in sense of well-being and strength. On the fifth, sixth, seventh and eighth days of the study, in every instance, a slight but definite reticulocytosis appeared. The reticulocytes did not rise above five per cent, but the white cell count, which was extremely low in the two patients with pernicious anæmia, increased strikingly during the period of reticulocytosis. This increase was principally in the polymorphonuclear leucocyte series. One hundred milligrams of vitamin B_6, incubated with 100 c.c. of normal fasting human gastric juice, was given orally to one of the patients with pernicious anæmia after reticulocytes and white blood cells had reverted to the original low level, with a response identical to that observed following the administration of vitamin B_6, intravenously.

These findings suggest that vitamin B_6, when administered in large amounts, has a definite effect upon the hæmopoietic system of human beings who have macrocytic anæmia of pellagra or pernicious anæmia in relapse. This substance does not, however, in our opinion, act specifically either as the true anti-pernicious anæmia factor or as the extrinsic factor of Castle.

This study, an account of which was read before the Academy of Medicine of Cleveland, December 15, 1939, was aided by grants from the John and Mary R. Markle Foundation and Anheuser-Busch, Inc.

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[1] Fouts, P. J., Helmer, O. M., Lepkovsky, S., and Jukes, T. H., 'Production of Microcytic Hypochromic Anemia in Puppies on Synthetic Diet Deficient in Rat Antidermatitis Factor (Vitamin B_6)", *J. Nutrition*, **16**, 197 (Aug. 10, 1938).

[2] McKibbon, J. M., Madden, R. J., Black, S., and Elvehjem, C. A., "The Importance of Vitamin B_6 and Factor W in the Nutrition of Dogs", *Amer. J. Physiol.*, **123**, 102 (1939).

Effect of Stilbœstrol on the Ovaries of Hypophysectomized Rats

VARIOUS authors have reported that small doses of œstrogen injected in the intact adult rat cause an increase in ovarian weight, generally attributed to an increase in the secretion of luteinizing hormone from the pituitary[1].

Comparatively large œstrogen dosage causes a decrease in ovarian weight in the intact animals. The available evidence strongly suggests that this is due to a depression of hypophyseal activity[2]. So far as can be ascertained, however, little work has been done on the action of œstrogens on the ovaries of the immature hypophysectomized rat, though such a preparation should give valuable information about the direct action of œstrogens on the ovary. Accordingly, immature (40–50 gm.) female rats were

hypophysectomized and a solid tablet of œstrogen was implanted subcutaneously two days after operation. The œstrogen used was the synthetic compound diethylstilbœstrol[3]. Two important effects were observed: first, that the œstrogen tablet prevented or greatly retarded the atrophy of the ovary that normally occurs after hypophysectomy, and secondly, that the response of the ovaries to the injection of pregnant mare serum was markedly increased with more pronounced luteinization of the membrana granulosa. Pregnant mare serum is mainly follicle-stimulating in action and has a much greater gonadotrophic action in intact immature rats than in hypophysectomized rats[4] The tests on this substance were carried out as previously described[4], the animals being killed fifteen days after operation The results are summarized in the accompanying table.

Condition of rat and treatment	Without œstrogen		With œstrogen	
	Mean wt of ovaries (mgm)	No of rats	Mean wt of ovaries (mgm)	No of rats
Normal	11·6 (10–13)	5		
Hypophysectomized 10–15 days post-operative	3·6 (2–7)	13	9·0 (6–15)	9
10 mgm *PMS* 10	42 (27–59)	4	112 (79–168)	3
20 mgm *PMS* 10	71 (57–95)	5	202 (106–250)	3
2·5 ml *PMS* 11	35 (24–46)	5	81 (52–97)	3

PMS 10 is a concentrated extract of pregnant mare serum diluted with lactose, *PMS* 11 is a sample of pure serum diluted five times

While it would be premature to speculate on the wider implications of these results, it is obvious that no action on the pituitary gland can be involved nor can the maintenance of corpora lutea play any part, since they are absent in the immature rat ovary. It is also clear that the role taken by the pituitary in the greater response of normal rats to gonadotrophic stimulation compared with the response in hypophysectomized rats will have to be reconsidered It should be emphasized that the dose of stilbœstrol absorbed (as measured by weighing the tablets before implantation and at autopsy) was large, being 150–200 μgm. per day This dose is much larger than any previously used in this connexion[5]. It is interesting to note that even these large doses did not produce any increase in the ovarian weight for normal animals of this size, so that œstrogen cannot be regarded as strictly gonadotrophic in the usual sense of the term.

Experiments are in progress to give more detailed information regarding the quantitative relations and histological changes of the œstrogen effect, and to test the reaction with other gonadotrophins.

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Feb. 14.

[1] See "Sex and Internal Secretions", ed E Allen, pp. 505, 987–992 (London Baillière, Tindall and Cox, 1939.)

[2] See Deanesly, R., *J. Endocrinol*, 1, 36 (1939)

[3] Dodds, E. C., Golberg, L, Lawson, W., and Robinson, R., NATURE, 141, 247 (1938).

[4] Noble, R. L., Rowlands, I. W., Warwick, M. H., and Williams, P. C., *J Endocrinol*, 1, 22 (1939).

[5] Fevold, H. L, Hisaw, F. L, and Greep, R. O., *Amer J. Physiol*, 114, 508 (1936).

Experiments in Non-Sensory Cognition

Two independent researches in this field have recently yielded mutually supporting results of considerable interest.

One of us (W. W. C) used simple drawings as test material In order to exclude processes of rational inference, and coincidental thinking, the subjects for these were selected by a random method immediately before each trial Fifty such 'originals' were used, in five experiments of ten originals each About 250 percipients took part, of whom none was ever in the same room as an original during a trial. In nearly all cases the original was put up in the experimenter's study and the percipients recorded their impressions, mainly by drawing, in their own homes The whole of the material thus obtained (about 2,200 drawings) was marked against all fifty originals by a judge who had not been concerned in the experiment and did not know which original was which Thus there was no possibility of the percipients inferring the probable nature of the original, or of their knowing it by sensory means, or of the judge's predilections biasing the outcome.

It was found (*a*) that percipients scored significantly more 'hits' (resemblances) on originals of experiments in which they were working, as compared with the originals of experiments in which they were not working, than would be expected on the null hypothesis that there is only a chance connexion between the originals used and the drawings produced ($P < 0{\cdot}0001$); and (*b*) that 'displacement' occurred to a significant extent; that is to say, 'hits' were not necessarily made on the same occasion as that on which the original concerned was displayed, but might be early or late, though most frequent on or near the occasion of display.

The other of us (S G S) used specially randomized packs of cards, of which each bore one of five different symbols which percipients were required to name, under experimental conditions very carefully devised to exclude completely the 'leakage' of sensory clues to the percipient. A total of 128,350 guesses in 5,134 'runs' of 25 each was collected from 160 percipients In 57,450 of these, the experimenter looked at the card while the percipient was guessing; in the remaining 70,900 cases he did not The results at first sight were null, for in the first series the excess of successes over the expected number was only 51, which is less than the standard deviation, and in the second there was a deficiency of 160, which is only 1·50 times the standard deviation

The discovery of a displacement effect, as recorded above, however, suggested a possible reason for the failure to score, namely, that percipients' guesses might refer to cards a few places before or after the one at which they were aimed It was accordingly decided to examine the number of hits made on cards 1, 2, 3, etc., places before and after the guess.

As a start, two percipients, one of whom had done 2,000 guesses and the other 800, were scored in this way up to a displacement of eight positions in each direction. In the first case, the three central positions show an excess of 178 hits over expectation, equivalent to 5·82 times the standard deviation, giving $P < 10^{-8}$; in the other, the excess is 86·8, or 4·49 times the standard deviation, giving $P < 10^{-5}$. Either of these gives a highly significant result, even if taken as the best sample of the whole material.

Thus the results of the card-guessing experiments confirm the displacement effect discovered in the

experiments with drawings; and these have led to a type of effect in the card-guessing being brought to light which might otherwise have escaped notice.

Full substantiatory details of both investigations will be published shortly

W. WHATELY CARINGTON.
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Feb. 4

A Mendelian Situation in the Birthcoat of the New Zealand Romney Lamb

IN our work on the inheritance of the abundance of halo-hairs in the birthcoat of the New Zealand Romney lamb, interest has become centred in a genetic situation which we find ourselves a little surprised to encounter in a character of a marketable product of livestock other than colour. While complexities are not lacking, it is plain that we are dealing with something more clear-cut than the usual multifactorial flock of factors defying genetic analysis.

Lambs with gross abundance of halo-hairs on the main area of the body, as well as on the extremities, are reported by breeders to make their appearance from time to time. It is safe to say, however, that they are not very common. These 'gross' lambs we call N-type, N being the initial letter of the name of the breeder, Mr. N. P. Nielsen of Tiakitahuna, who gave us our first ram of the type in question. In several N-type lambs born in various experimental matings, it is concluded from their ancestry and/or breeding performance, that the genetic basis is multifactorial, but in most N-type lambs born at the College the genetic basis is manifestly relatively simple. This is a summary of our findings from experiments in which well over a hundred N-type lambs have been produced.

LEFT N-TYPE, RIGHT NOT-N-TYPE. THE LATTER HAD NO HALO HAIRS ON THE MAIN AREA, BUT MANY NOT-N LAMBS HAVE SOME HALO-HAIRS THERE, EVEN LARGE NUMBERS, BUT CHARACTERISTICALLY FEWER THAN N-TYPE. THESE LAMBS ARE TWINS. THE FATHER WAS N-TYPE, THE MOTHER NOT-N, WITH NO HALO-HAIRS. THE SIRE OF THE FATHER WAS N-TYPE, THE DAM OF THE FATHER HAD NO HALO-HAIRS.

(1) Breeding results from two N-type rams, not related to one another, together with results from rather numerous N-type descendants of theirs, make it look as if this kind of coat were conditioned by a single dominant factor linked with the sex-influenced factor for horns, with crossing-over occurring about once in ten or twelve times.

(2) Some attention has been paid to horns by one of us (J. A. S.). It happens that horns have been rather plentiful in non-N experimental stock. On the average the horns are decidedly bigger in N-type than in non-N rams.

(3) Several pieces of evidence indicate that this N factor (or possibly N complex) sometimes comes to incomplete expression, so that the lambs fall a little short of the abundance of halo-hairs regarded as properly gross. It may suffice to mention the following two points.

(a) In back-crosses of horned N-type rams deemed double heterozygotes, most of the near-N male offspring have horns.

(b) Most of the ewes chosen for back-crosses had few or no halo-hairs on the back. The lambs could be separated almost sharply into two groups, those of the N-type and near-N-type and those with few or no halo-hairs on the back. There were very few with intermediate abundance of halo-hairs.

(4) In back-crosses of heterozygous N-type (so regarded from their parentage) to not-N, some ratios are almost exactly 1 : 1, but in the offspring of some tested rams there is a deficiency of N-type, that is, an excess of lambs definitely not-N. Whether this deficiency of N-type is significant, and how it is to be interpreted if it is real, are matters calling for further experiment.

(5) One N-type ram, with all his parents and grandparents not-N, was mated with not-N ewes with no, or few, halo-hairs on the back. He sired 3 N-type, 1 near-N, and 60 not-N. So far he has been mated with only four of his own daughters (all not-N), getting one of the N-type lambs and the near-N lamb just mentioned, and 2 not-N. One of the other N-type lambs was from a daughter of one of our original N-type rams.

(6) (a) A not-N ram sired by the original Nielsen ram was mated with not-N ewes sired by the same ram. He gave 10 lambs, all not-N.

(b) A not-N ram (without any halo-hairs on the back), the son of an N-type son of the original Nielsen ram, was mated with not-N ewes (with no or few halo-hairs on the back), daughters of the original ram or of one or other of his N-type sons. The result was 2 typical N-type, 9 not-N with halo-hairs absent or of low abundance on the back.

We are able to suggest more than one somewhat elaborate explanation of our list of facts. Two linked complementary factors for N-type are favoured by one of us (P. R. McM.), while a dominigene is the pivot of another hypothesis. We are reminded of the recent work on another domestic animal by Kurzbauer and Marchlewski, who find that "two yellow dogs may produce black offspring and two black ones may produce yellow"[1].

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Dec. 11.

[1] *Animal Breeding Abstracts*, 7, 2 (1939).

Air Transport, Insects and Disease

I HAVE read with much interest Dr. A. D. Imms's review (in NATURE, January 13, p. 76) of Mr. Sarel Whitfield's paper entitled "Air Transport, Insects and Disease", and agree with both the author and the reviewer that the present position of this problem is still unsatisfactory

In Dr Imms's opinion, "no adequate and reliable control of insects in aircraft has been discovered", which is true of insects in general, but is scarcely so of the class of insects to which he especially refers, namely, the carriers of malaria and yellow-fever The evidence brought forward in our paper[1], supported as it was by the opinion of reliable observers, shows that adequate control of mosquitoes in aircraft can be effected if the measures devised by us, and by Dr Park Ross, are carried out

The reason why these measures have not been generally adopted is, first, because the provisions of the International Sanitary Convention on Aerial Navigation place the responsibility for insect destruction on the ground sanitary authorities of the various countries through which the aircraft passes, and secondly, because these local Governments are averse to delegating their responsibility under the Convention to aircraft companies, with the result that a variety of different insecticides is still being used, and the manner of their application is equally varied

Dr Imms's criticism is valid when applied to some other arthropods, and we have had correspondence recently regarding the possible carriage in aircraft of the cotton boll worm and of the Japanese beetle. We realize that the procedure devised for mosquitoes would be entirely ineffectual when applied to such parasites, and eminent entomologists, both at home and abroad, have been asked to advise us regarding a substance lethal to these arthropods and yet of practical application in a passenger-carrying aeroplane.

Until such a preparation has been found, it is obviously impossible for aircraft companies to proceed in the matter We consider that we have a method, adequate and trustworthy, against mosquitoes, but until the biochemical side of the problem has been extended, we cannot take measures to destroy the more resistant parasites which may carry veterinary or agricultural disease.

If Mr Whitfield's valuable monograph, and Dr Imms's review of it, serve to direct attention to the nature of the problem awaiting solution, they will have done a great service to aerial transport

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Imperial Airways Limited.

[1] Mackie, F P, and Crabtree, H. S, 'Destruction of Mosquitoes in Aircraft", *Lancet*, 447 (August 20, 1938).

Points from Foregoing Letters

THE presence of steric inhibition of coplanarity in certain polymethine (cyanine) sensitizing dyes is discussed by S. E. Sheppard, R. H. Lambert and R. D. Walker. It is adduced as a cause of modified spectral absorption and inefficiency of optical sensitizing of silver halides.

A. G. Mistretta and F. F. Nord describe experiments and give indications of a rule with regard to the relation between solvent and yield in the Gattermann synthesis using sodium cyanide.

P. J. G. de Vos finds a second maximum in the curve for cosmic ray secondaries from copper similar to that observed by other workers using lead.

In view of the large number of 'free' electrons present in graphite, namely, one per carbon atom, and the very low degeneracy temperature of the electron gas, indicated by the magnetic data, it is pointed out by K. S. Krishnan that the electronic specific heat in graphite should be much larger than in most metals. The available experimental data support this conclusion.

It is known that both liver and yeast relieve some of the symptoms of pellagra and pernicious anæmia, and also that both contain vitamin B_6. R. W. Vilter, H. S. Schiro and T. D. Spies have administered heavy doses of this vitamin, intravenously and orally, to patients suffering from pellagra and pernicious anæmia, with beneficial results

P. C. Williams states that the atrophy of the ovaries that follows hypophysectomy may be prevented, in the immature rat, by the implantation of a tablet of the synthetic œstrogen stilbœstrol two days after the operation. The ovaries thus maintained respond to the injection of pregnant mare serum, both quantitatively and qualitatively, much more like the ovaries of intact rats than like those of untreated hypophysectomized rats.

W. W. Carington and S. G. Soal, working with simple drawings and with special cards respectively, under the most rigorous possible conditions, find significant cognitive relationships between the test material and the guesses made. In the first case, percipients score more hits on the drawings used in the experiment in which they were concerned than on those of other experiments; in the second, two sample percipients have been found to score heavily above expectation on the three cards preceding, coinciding with and following the guess, taken as a group.

Certain lambs of the New Zealand Romney breed are born with great abundance of so-called halo hairs in the fleece. F. W. Dry, P. R. McMahon and J. A. Sutherland have examined this condition genetically. Mendelian inheritance of the character is indicated, but no agreement has been reached as to the factors and mechanism concerned.

The Chief Medical Officer of Imperial Airways, Ltd., writes to confirm a comment made by Dr. A. D. Imms that the present position with regard to air transport in its relation to the transmission of disease by insects is unsatisfactory. He states that satisfactory measures against mosquitoes have been devised, but are not generally adopted because the responsibility for taking action is in the hands of the ground sanitary authorities instead of the aircraft companies. Measures against insects other than the mosquito are being sought.

RESEARCH ITEMS

Mangarevan Archæology

IN the course of the expedition to the Mangarevan Islands of the Bernice P Bishop Museum, Honolulu, under Dr. Peter H Buck in 1934, an archæological survey of sites on Mangareva itself as well as of stone structures on neighbouring atolls was made by Kenneth P Emory (*Bull* 163, Bernice P. Bishop Mus. 1939) Owing to the use of the stone for building by missionaries all important structures in the Mangarevan group have now disappeared, but fortunately the stone structures left by the Mangarevan inhabitants of Temoe atoll, 25 miles to the south-east, are intact Here the largest structure is a platform 21 feet wide and 58 ft long It has an unenclosed court on the inland side extending 30 feet from the face of the platform Across the court face are two high steps The largest structures in Temoe had burials in small vaults at the top In two maraes, open vaults at ground level are larger and more carefully constructed than the vaults containing burials. These, it has been reported, were considered the dwelling-place of the god of the marae The nearest parallels to the Mangarevan maraes are certain image *ahu* of Easter Island, in which the platform is stepped on the court side, and at the top of which burials were made The Easter Islanders added images of stone along the back of the platform Probably the features shared by the Mangarevan and Easter Island structures had a common origin, possibly original features of Marquesan culture with which both Mangareva and Easter Island exhibit affinities, but which evidently have been modified in the Marquesan, where sacred structures are not uniform, nor of the type of Mangarevan and Easter Island sanctuaries. However, like the Easter Islanders the Marquesans set up large images on their sacred structures, but the Mangarevans lacked both the timber and the tuff which would have permitted the making of such images

Toxicity of Snake's Venom

IT is the general impression, and has been definitely stated by workers in America and Australia, that snakes in captivity from which venom is repeatedly extracted gradually yield smaller quantities, and that the venom decreases in potency These statements are not confirmed by the observations of N O'Connor Wolff and Thomas S. Githens made upon a group of twenty-one water moccasins (*Agkistrodon piscivorus*), used for venom extraction over a period of two years (*Copeia*, 234, 1939) The 'milking' took place at irregular intervals, the longest time between extractions being six months and the shortest three weeks The venom having been collected was measured, centrifuged to remove epithelial scales, and then dried either by gentle heat or in a desiccator under vacuum Toxicity was determined by intravenous injection into pigeons of a solution of the dried venom to determine the minimum lethal dose A table is given recording complete data regarding the extractions over the two-year period. At the earliest extractions the average amount of venom per snake on the first three occasions was 0·500, 0·486 and 0·517 c.c., while on the last three extractions the averages were 0·550, 0·777, and 0·722 c.c. Similarly the first minimum lethal doses averaged 2,000, 1,300 and 1,577 per snake, while the last three averaged 2,520, 1,970 and 2,500 The table shows a considerable range of fluctuation throughout the period, but seems to establish the contention of its authors that neither quantity nor toxicity decreased owing to repeated extractions

Marquesan Insects

THE Pacific Entomological Survey, dealing in the main with the fauna of the Marquesas Islands, is a project organized and directed by institutions in Hawaii As the result of expeditions sent out under its auspices a large addition to knowledge of the insects, and related arthropods, of the area concerned has been made Under the title of "Marquesan Insects—III" published in 1939 as *Bulletin* 142 of the Bernice P Bishop Museum, Honolulu, the latest contribution on the work of the Survey has come to hand and it marks the end of the present programme The longer articles in the *Bulletin* are concerned with Crustacea (Talitridæ), Spiders, Acarina and Chelonethida Among the insects themselves, the article on Scolytidæ by C. F C. Beeson is of interest since it records the first known bark beetles from the Marquesas; more than two hundred specimens, representative of five genera and twenty-one species, were dealt with Two new genera of Hydrometridæ, or water-bugs, are described by H. B Hungerford, and a new Blastophaga from the indigenous Ficus of the Marquesas is dealt with by G Grandi Other papers on the Insecta include contributions by H H. Knight on new species of the hemipterous family Miridæ.

Experimental Taxonomy

J W. GREGOR (*New Phyt*, 38, 293-322; 1939) has continued his analysis of wild populations by examining the differentiation of North American and European plantains. He shows that *Plantago maritima*, *P alpina*, *P carinata*, *P juncoides*, and *P. oliganthus* of North America, Greenland, and Europe form an inter-fertile group which is diploid, while Alpine tetraploids form another group He points out that variations within one sub-region overlap with those of another, but that the means of measurable characters within a population may differ from the mean of another population Thus bracts and sepals of North American plantains are broader in proportion to length than those of northern Europe. The mean values of the sub-regions regarding this index and that of the ratio scape length to spike length show a gradient from low values in western America, rising in eastern America, Iceland, Faroes, Britain to a maximum in Sweden, and falling again in southern Germany. Data regarding various other measurable characters show similar geographical gradients, but it is important to note that irregularities in small localities sometimes occur. The author points out that classification founded upon the complex of characters in an individual is not so useful in experimental taxonomy as that of the average of characters in a population. The data illustrate the fact that growth and physiological characters behave in a similar manner to qualitative or morphological characteristics.

Diamond Deposits of Tanganyika Territory

ALTHOUGH diamonds have been worked in Tanganyika for sixteen years, no comprehensive publication covering the geological and economic aspects of the industry has appeared until now. *Bulletin* 12 of the Geological Division, T T., by G. J. Williams, comes at an opportune time, just as the original finds are reaching the end of their productivity, since it gives an account of most of the country in which kimberlite (the home of the diamond) is known to occur, and provides a useful guide to prospectors in other areas The kimberlite occurrences are mainly in the central granite batholith of Tanganyika The individual pipes tend to be localized at or near geological contacts (for example, against dolerite dykes or remnants of basement rocks) or fracture zones. There are, however, groups of pipes without visible connexion with pre-existing structures, owing—at least in part—to the existence of thick covers of superficial deposits Here the search for such minerals as ilmenite, garnet and zircon in the subsoil is most likely to lead to the body of kimberlite from which they were derived. Areas likely to repay prospecting are suggested From evidence in Tanganyika alone, the age of the kimberlite masses cannot be determined exactly They are, however, pre-Pleistocene and post-early Jurassic, a time-range within which falls the late Cretaceous age established for the South African pipes The *Bulletin* contains a map of the kimberlite province of Tanganyika and also a map showing the distribution of kimberlite pipes and fissures throughout Central and Southern Africa

The Quetta Earthquake of 1935

THIS earthquake has been studied in some detail by K. R Ramanathan and S M. Mukherji of the Colaba Observatory, Bombay (*Rec Geol. Surv India*, 73, Pt 4, 483 513, 1938) It will be recalled that damage was caused by this earthquake along a tract of land extending from Baleli just north of Quetta, through Dingar and Mastung to Mand-i-Haji, and including the Shirinab Valley to the west of the Mastung–Kalat Road. It is an area about 68 miles long and 16 miles wide The surface crack extended from about 30 3° N., 66 9° E, to 29 1° N, 66 5° E, the centre of the region of maximum disturbance being 29·7° N., 66·7° E The seismological data used for the present study were the seismograms from Bombay, Agra, Calcutta, Hyderabad and Kodaikanal in India, together with fifteen seismograms from foreign observatories. Miss Bellamy, of Oxford, supplied readings from 142 observatories. From these data the authors concluded that the best position for the epicentre was 29·6° N., 66·5° E., slightly to the south-west of the permanent maximum displacement but well within the region of maximum macroseismic effects The origin time of the earthquake was May 30d. 21h. 32m. 58·5s G M T. Among the prominent features of the seismograms were the gradual increase of amplitude interrupted by larger and larger impulses, and the large amplitudes of the long waves compared with those of the preliminary phases, suggesting block movement and a shallow depth of focus (less than 10 km.) This was also deduced on other grounds. The energy of the earthquake was estimated to have been about 10^{21} ergs. or 1/2,000 that of the Great Assam earthquake of 1897. A list of aftershocks recorded at Agra is given.

Viscosities near Absolute Zero

WITH financial aid from the Smithsonian Institution, Prof. W H. Keesom and G. E. Macwood have determined the viscosities of liquid helium and hydrogen and of hydrogen vapour at temperatures near the absolute zero (*Leyden Comm.*, No. 254). Their method is that of the oscillating disk, which is 5 cm. in diameter and is suspended by a phosphor bronze wire of 0·05 mm diameter and 25 cm long in a cylindrical box of a little greater diameter, the top and bottom plates of which can be placed at various distances from the disk. The decay of the torsional oscillations of the disk were observed by the mirror, telescope and scale method. The apparatus was standardized by using in it helium gas of known viscosity. The viscosity of hydrogen is normal in both states For the liquid it decreases from 210 micro-poise at 15° K linearly to a little more than 150 at 18° K, then more slowly to 140 at 20° K. For the vapour it increases from a little less than 10 micro-poise at 14 5° K to 13 at 21° K linearly, and is independent of pressure The viscosity of liquid helium is abnormal. It increases from 1·8 micro-poise at 1 3° K at first slowly, then rapidly to 17·5 at 2·1° K., where there is some uncertainty From this point it increases to 25 at 3° K. and to 29 micro-poise at 4° K

Observations of the Zodiacal Light

MOHD A R KHAN, Begumpet, Deccan, has sent a description of his observations of the zodiacal light on December 17, 1939, at 5.30 a.m, Standard Indian Time The phenomenon produced the impression of two cones, one within the other, the inner cone being the brighter of the two. The apex of the inner cone rested on γ Virginis, and ξ Virginis, β Libræ and μ Serpentis lay approximately on its northern boundary On the southern boundary were 76 Virginis, 20 Libræ, and φ^1 and φ^2 Lupi The apex of the outer cone appeared to extend to ρ Leonis, and 109 Virginis and π Hydræ were on its northern and southern boundaries, respectively. The light thus presented the appearance of a tall double cone, broad at the base near the horizon, and getting quickly narrower and narrower towards the apex A similar configuration was observed on December 12 at 5 a m

Structures of Sulphuryl and Thiophosphoryl Fluorides

As the relations between bond length and bond character are not well understood for molecules containing semipolar double bonds, the investigation of SO_2F_2 and PSF_3 by the electron diffraction method (D. P Stevenson and H. Russell, *J Amer Chem Soc*, 61, 3264; 1939) is of interest. The distances predicted by the standard covalent radii are P–F 1·74 A, P–S 1·95 A., whilst those found are 1·51 and 1·85, indicating resonance with a larger proportion of ionic structures than for the corresponding chlorine compound, and due to a considerable triple bond character made possible by the large electro-negativity of fluorine and the small difference in electro-negativity between phosphorus and sulphur. The relatively small angle 99·5° F–P–F is not interpreted for lack of data The S–F distance in SO_2F_2 is 1·56 A, which is less than the single bond distance calculated from the standard covalent radii, but the shortening is not so great as is found with the fluorine derivatives of phosphorus. Although there is much more shortening in the S–Hal bond in SO_2F_2 than in SO_2Cl_2, the S–O distance 1·43 A. in SO_2F_2 is the same as that in SO_2, SO_3 and SO_2Cl_2.

PREHISTORIC PEOPLES IN SOUTH AFRICA

DR. ROBERT BROOM'S recent discoveries in the Transvaal of important evidence bearing upon the origin and descent of man have tended to overshadow another field of anthropological investigation in South Africa which, though more localized in its application, ranks in African ethnology as scarcely of lesser significance for studies of the evolution and distribution of prehistoric racial types The problem in question arises from the recognition by Dr. A Galloway* in the skeletal material from the remarkable prehistoric sites of Mapungubwe and Bambadyanalo, recently excavated, of a new race, the Bush-Boskopoid, associated with and apparently responsible for the mining operations which figure conspicuously among the activities of the prehistoric inhabitants of Rhodesia The physical characters of the race of miners, their relation to the Bantu-speaking peoples who later came to form the predominant population, and how far the Bush-Boskopoid of Mapungubwe constitutes the type, are discussed in a series of communications made recently to the Rhodesia Scientific Association (*Transactions*, 37; 1939).

In reference to certain human remains found in excavations at various times since 1934, which are recorded in detail by A. E Phaup, the evidence of the prehistoric skeletal material as a whole from Rhodesia is summarized and discussed by Prof. M. R Drennan.

By way of preface it is remarked that the remains, both male and female, appear to be those of indigenous natives living under tribal conditions, and using metals They differ from the present Negroes of South, East and West Africa in that their skulls were longer and narrower than the average, their faces were more prognathous and their brains smaller. They were also shorter. They resemble the "Bush-Boskop" race of Mapungubwe and Bambadyanalo, and are similar to the more modern "Hottentot" type, seeming intermediate between Bush and Bantu, with some of the characteristics of both. They also show affinities to the Cro-magnon race of Europe. They buried their dead in caves and the ancient workings of prehistoric gold mines. The bodies were probably clothed or covered, and personal ornaments and small utensils were left on or near the body.

The remains were found in different conditions throughout Southern Rhodesia as follows:

Penhalonga On the Umtali Mission Farm among a group of granite blocks and under the largest was a natural wedge-shaped cavity 50 ft long and 20 ft. wide, which had been walled in. The floor was covered with bones and scattered groups of small beads of blue glass and ostrich-shell. Four skulls, three male and one female, were available for examination and were pronounced in a report by Dr. Drennan at the time to be "a good sample of some native group, . . quite comparable to the existing groups of natives"

Makoni District. From a large limestone cave on Romsley extension farm came a human skull and tibia, animal bones, clay pots, grinding stones, a copper bangle and a spear-head. Dr. Drennan pronounced the skull to be female and "typically Bantu", closely resembling two Mashona skulls.

Carolina Claims, Mazoe. An almost complete female skeleton was collected by the late T. H. Wilson, of the Geological Survey, from the Carolina gold claims, about a mile south of Jumbo siding, in workings in a small hill of banded ironstone. The skeleton was found in reopening one of the old shafts. With it were eight rusty iron rings. Dr Drennan's report states that the remains are those of a young female of native type aged about twenty years. The skull is comparable with that from Penhalonga, and "definitely negroid in every respect".

Eureka Mine, Sipolilo. Two fossilized fragments of a human femur were found in an ancient working of the gold mine. They show extreme degrees of platymeria and pilastering, features practically never occurring in this degree in Europeans, moderate in Bantu, but a marked feature of Bushman and Hottentot. A fragmentary skeleton of an infant found later, while indeterminate owing to age, is as regards the cranium typically 'negroid', while the mandible is definitely 'Bush-Boskop'.

Inyanga. Fragments of a skull from the Van Niekerk ruins, found lying under a large granite slab, apparently belong to a young female of about fifteen years of age. The measurements are very similar to those of the female from Penhalonga

In his further review of the skeletal material from Southern Rhodesia as a whole supplementary to the report to which reference is made above, Dr. Drennan states that his interest in the ancient gold miners and other prehistoric inhabitants of Southern Rhodesia was first aroused by the skull from the Gwalo mine presented to the South African Museum by Sir Clarkson Tredgold in 1917. In this skull the features of Bushman, Hottentot and Bantu types are curiously and strikingly blended. Next came the skull from the Planet Mine, Bulawayo, which, while showing certain Bantu characters, is predominantly Bushman, and with reservation might be assigned to the Bush-Boskop group.

The material described by Mr. Phaup, though all legitimately prehistoric Rhodesian, falls into two groups—those with, and those without, a definite association with mining activities. In the mining group fall the Mazoe, the Eureka, and the Van Niekerk specimens; they all belong to the same physical type and are all women or children. The Makoni skull also belongs to the same physical group; but the group from Penhalonga seem to approximate more to the modern type.

While Dr. Drennan finds a considerable measure of agreement with Mapungubwe, there are also significant differences. The material from Mapungubwe and Bambadyanalo, to which Galloway applies the term Bush-Boskop, is not homogeneous, but includes three or four different elements. In the present series, however, there is no instance of the absolute long-headedness or big-brainedness of the Boskop race, so prevalent at Mapungubwe and Bambadyanalo, nor is their relative long-headedness to be accounted for as a mixture of Bushman and Boskop strains For this we must look to a pre-negro strain. The pronounced prognathism of the present group emphasizes their negro character; but it is absent at Bambadyanalo.

It is thus impossible to reconcile the two findings at present; but it may turn out eventually that it is a difference between the exploiters of gold on one hand,

* Galloway, A., "The Skeletal Remains from Mapungubwe in 'Mapungubwe: Ancient Bantu Civilization on the Limpopo' ". Edited by Leo Fouché Cambridge, 1937.

who show a preponderance of Bush-Boskop character typical of the southern prehistoric peoples, and of the actual miners on the other hand, who show more negroid character inherited from northern pre-negro types such as Elmenteita man.

Upper jaws of a Boskop type attracted the attention of Prof. Raymond Dart in 1938 to the Cornucopia site at Rusape, Umtali, on which Mr. Barnes Pope had been engaged in trenching with the view of discovering the nature of the material there, which had attracted the ancient industrialists responsible for the workings of which evidence had been discovered. The appearance of a Boskop type was unanticipated as all previous skeletons from ancient workings in Rhodesia had been described as Bantu (Keith, 1931) or Bush (Drennan, 1930).

Mr. Barnes Pope, excavating in depressed areas with a luxuriant growth of trees and herbage, which had been disturbed on a grand scale at some past period of time, revealed consistently four layers: (1) the vegetation layer, (2) the gravel or barren layer, (3) the fertile layer, (4) the bed-rock layer.

The bed-rock layer consisted of granite boulders and the disintegrated granite which forms the basis of the area in which the ancient miners worked. The material which attracted them was either the rich brownish-black iron oxide grains, to be used either as a cosmetic or as a source of metallic iron, or alternatively the tin, which though not now found in paying quantities, may originally have been rich. This layer varies from three to forty-five feet.

The fertile layer, from which all objects found underground have come, varies from three inches to several feet in thickness but usually is only twelve inches in height. Here are crude potsherds, skeletal remains, beads, slag, a button of melted tin, etc. Curious arrangements of objects have been discovered. Under a flat stone were thirteen stone phalli. Here there were no bones; but in another place a skull was found accompanied by fifteen phalli. A second skull was found at a depth of fifteen feet, but without accompanying objects.

It may be inferred that two forms of burial were practised: (*a*) simple and sometimes phalli accompanied burials at the mining face, probably burials of miners; and (*b*) cylindrical stone monument burials in the 'mine-filling', probably burials of important individuals.

The 'mine-filling' process can be separated into two distinct phases represented by the sterile layer, composed mainly of earth displaced by the miners, and the vegetational stratum-humus, twelve to eighteen inches in thickness, representing the flux of a considerable period of time—certainly several hundreds and it may be even thousands of years. At Zuurberg the humid period represented by the black soil over the former land surface is dated tentatively at 1800 B.C.

This date, which applies to the earliest levels in which occur 'Bushman' burials on the Zuurberg site, is correlated by Wells with the "classical rainfall maximum" of C. E. P. Brooks (1922), dated at a period extending from 1800 B.C. to A.D. 500. The assessment of rate of deposition in South Africa, however, is notoriously difficult and uncertain. The period under investigation was one of aridity and erosion, rather than of precipitation. The rate of deposition of earthy vegetable layers at the present day in South Africa has not been determined; but while it would be rash to jump to the conclusion that the 12–18 in. earthy vegetable layer is referable to the same period as the Zuurberg material, the tentative suggestion of "even thousands of years" may be no exaggeration.

At the same time, cultural evidence from certain sources which have been under review may point to the later limits, for which an approximate dating might be suggested. While weapons and implements of iron are very similar to those collected on ancient ruins of medieval date, or even to those of the modern iron-worker, certain assemblages of beads are comparable to those of the Great Zimbabwe acropolies, that is, of the ninth to tenth centuries of our era, though here again allowance must be made for survival in fashion.

Turning to the skeletal material found on the Cornucopia site, L. H. Wells, in describing the two skulls, stresses their great length and relative narrowness. Thus the more complete of the two measures 201 mm. at its maximum length, while the maximum breadth is only 130 mm., giving a cephalic index of 65·0. The corresponding figures for the second skull are estimated at: maximum length, 190 mm.; maximum parietal breadth, 127 mm.; cephalic index, 66·5 approximately. The cranial capacities, respectively, are 1,425–1,500 c.c. and 1,300–1,350 c.c. In both, the bones are thick and massive and slightly mineralized.

The feature, however, which is singled out as especially noteworthy is the remarkable size of the palate and the teeth. In the first skull, the longitudinal and transverse diameters fall just within the maximum recorded for the South African Negro while the height of the palatal vault above the grinding surfaces of the teeth is greater than in any Negro. Moreover, the form is different, the incisors forming an almost straight line between the canines. The palate is thus quadrilateral rather than horseshoe-shaped. Except that it is much higher in the vault, this palate agrees with the Boskop type.

Both skulls agree in presenting very few negro features, while of their non-negro features, the majority are proper to the Boskop type.

Yet although these skulls recall the Boskop type, they also diverge widely from it. The significance of these findings becomes apparent on reviewing the skulls previously found in similar circumstances. The number found in Rhodesia is small. Skulls examined by Shrubsall and Keith were classified as of negro type, but probably these conclusions call for revision in the light of further knowledge. Galloway has recognized both Bush and Boskop features from Penhalonga. The Cornucopia find has revealed the association with an ancient occupation site of skeletal remains which are predominantly of non-negro type. They represent a type which there is good reason to believe preceded the Bantu-speaking Negro. Such a strongly marked Boskopoid type is already well known in the southern portions of Africa. The same elongated and low-vaulted skull has been found among the Hottentots and, it has been shown, can arise from the mixture of large-headed Boskop and small-headed Bush types. The most remarkable development of the last few years in South African anthropology has been the demonstration by Galloway (1937) that "a homogeneous Boskop-Bush population physically akin to the post-Boskop inhabitants of the coastal caves" was associated with the Iron Age civilization of Mapungubwe. It is concluded that the Cornucopia people, if not identical with the Mapungubwe type, are very similar in most respects.

A SLIDING RATE ELECTRICAL METER

IN a paper published in the *Journal of the Institution of Electrical Engineers* of January, Dr. Unz of the Iraq Petroleum Co., Ltd., has suggested a new type of electrical meter, to replace the existing maximum-demand indicators. The object of the maximum-demand indicators is to enable the supply station to charge its consumers not only in accordance with the number of electric units consumed, but also in proportion with the demand on the station at the time during which they were consumed. In the early days of the use of this system, the meter bill consisted of two components, the first being at a constant rate for all demands not greater than a certain minimum rate, and the second component being charged at a higher rate when the demand exceeded this rate. The object was to influence consumers to be economical with their lighting when they were consuming at the higher rate. Economy at these times is most important to the supply company, which is otherwise forced to buy large quantities of expensive reserve plant, used only for a short time every day when the demand is excessive.

Improvements to the demand-charging system have been effected by means of peak-load meters, load-levelling relays and time-switches, as well as by various refinements of the tariffs, but these are of limited application. A meter is required which would automatically fix the price level of each consumed unit as a function of the power at which it is applied, and integrate such prices to a total amount. The consumer would know that the price of a unit consumed at half load would be much lower than that consumed at double full load. He could therefore endeavour to reduce his electricity bill by improving the load factor to the utmost, but need never be afraid of being penalized for exceeding his usual demands. The supply undertaking, on the other hand, would have the full benefit of a rational and simple charging system, without the necessity of providing duplicate measuring instruments and wiring.

An integrating watt-hour meter having a curve for the speed characteristic instead of a straight line would serve the purpose. The meter readings would then not be in kilowatt-hours but in what might be termed 'key-units'. These readings would be proportional to the amounts of money due, as in load-rate prepayment meters or in double-tariff meters with a single counter train.

The speeding-up effect described above can be obtained in a meter either by making the driving torque proportional to a power of the load higher than the first, or by reducing the retarding torque of the brake. Dr. Unz states that the latter method is constructionally easier, and in addition it has the advantage that the existing driving elements with all their compensating devices can be left untouched. The constructional details of the proposed braking element are shown, its equivalent electric circuit is considered, and its performance discussed. The reconstruction of the meter characteristic is outlined, and the errors and compensation methods briefly discussed.

The device offers new facilities in the application of demand charges. It works on the same principle as a standard watt-hour meter, and deviates from the latter only in regard to its speed 'characteristic'.

THE MUSICAL PITCH OF ORCHESTRAS

IN the English edition of the second quarterly bulletin of the "Centro Volpi di Elettrologia" published in Venice last year, there is an interesting article by G. B. Madella surveying investigations which have been recently made on the frequency of the reference note of an orchestra. The history of this problem was discussed in an article in NATURE of November 5, 1938 (p. 820), by Dr. G. W. C. Kaye, who also described the proceedings of the international congress which made recommendations in 1939 (see NATURE, May 27, 1939, p. 905).

Madella describes a series of measurements made during a period of a month in the Electro-acoustic Department of the Istituto Elettrotecnico Galileo Ferraris in Turin at the request of the Italian Committee on Acoustics. Some of the results obtained are given below. A standard frequency of 400 was obtained from that of the institution standard, which operates at 1,000. This gives an accuracy quite sufficient for the purpose. The two tensions thus obtained having the unknown frequency and the frequency of 400 are then applied to a copper oxide modulator. The frequency beat obtained in this way is applied to the plates of an oscillograph and then registered by means of a photographic recording machine. The accuracy obtainable varies according to the time-length of the note studied; as a rule, it is about a tenth of a cycle. Attempts to apply stroboscopic methods were unsuccessful as these methods tire the eye of the observer and are therefore not suitable for systematic measurements.

The tuning frequency, on the average, was found to be above 435; during the transmissions of operas and symphonic concerts, values of the order of 441 were observed.

During the transmission of piano performances or of performances comprising pianos and vocal or string instrument groups, lower frequencies were nearly always observed, often in the neighbourhood of 435, with differences of less than 0·5 cycle. At a violin and piano concert the frequency most often heard was 437·1, but at a symphonic concert the frequency most frequently noted was 442, the maximum being 444·8 and the minimum 439·7.

The results are partly explained by remembering that when a piano is accurately tuned, the tuning is maintained without variations of practical importance. Wind instruments, even if well tuned at the

beginning, have a tendency after a time to increase the frequency of the emitted note because of the heating produced by the breath of the player. Finally, string instruments allow the player within certain limits to follow the tune of other instruments, and the same is the case with singers.

No evidence was found to confirm the generally stated order of variation in which the mean tuning frequency tends to increase during the execution of selections by an orchestra. The frequency of the pitch which is observed during the tuning of instruments before starting the performance tends to be maintained as a mean value during the whole performance. As few tests of this have been made, it would be advisable to make further investigations; if confirmed, it would be of importance in relation to the choice of the steps apt to modify the tuning frequency.

TEMPORARY PRESERVATION OF ANIMAL SPECIMENS

MR. J. R. NORMAN, of the British Museum (Natural History), has abstracted and translated the following from a letter he has recently received from Dr. Paul Chabanaud, of the Museum National d'Histoire Naturelle, Paris:

On learning the news of the sensational discovery of *Latimeria chalumnae*[1], there can be, I imagine, few naturalists who were not seriously perturbed by the thought that it was only by the merest chance that this extraordinary living fossil was not irretrievably lost. Indeed, our congratulations are due to all those who have succeeded in saving this priceless specimen, although we must deplore the fact that its final state of preservation is so far from satisfactory.

Even if fishermen do not often find a representative of the Mesozoic fauna in their nets, how very few of the interesting specimens captured by them daily throughout the world find their way to our museums or laboratories. Even in the case of the species well-known to science, the larger individuals are rarely, if ever, preserved, and our knowledge of the size attained by certain animals (for example, the halibut—*Hippoglossus hippoglossus* (L.); some of the Siluroids; and very many Elasmobranchs) rests largely upon hearsay, or upon the examination of fragments (for example, the 'saws' of *Pristis*).

Naturalists travelling abroad are compelled to forgo the collection of individuals exceeding a certain size (except in the form of skins), solely because their preservation by ordinary methods (alcohol or formalin) necessitates the use of containers so large that their transport is quite impracticable.

There is, however, an extremely simple and quite inexpensive method of preserving animals, both large and small, and in particular fishes: this is by the use of sodium chloride or sea salt. I speak with some knowledge on this subject, as I have used the method myself on many occasions.

All that is necessary is to place the animal in a basin or dish, or preferably on a board or something of a like nature, and to cover it with a heap of salt, being careful to introduce as much of the salt as possible into the mouth and gills, as well as into the abdominal cavity through an incision previously made in one side of the body. The effect of the salt, of course, is to absorb the fluids from the organism. After some hours, that is to say, on the next day at the latest, the specimen should be turned over, drained, and the diluted salt replaced by fresh.

If the animal is of small or moderate size no further treatment is usually required, but if of considerable volume it may be necessary to repeat the operation several times, care being taken to turn the body over each time. Naturally, the hygrometric state of the surrounding atmosphere will tend to accelerate or retard the process as the case may be.

The desiccation of the specimen must be made as complete as possible, since, of course, the sodium chloride does not fix the tissues, and its preserving powers depend entirely upon its strong hydrophilism, the organic tissues treated by the salt being dehydrated and at the same time rendered unsuitable for the proliferation of destructive organisms such as bacteria, moulds, etc.

Thus, it is absolutely indispensable, especially in warm and humid climates, to obtain this dehydration as rapidly as possible, the animal being, in fact, converted into a 'stock-fish', which can be readily packed in any sort of box or crate, with no other packing than the salt itself.

By using this method I have been able to obtain very large specimens of fishes (for example, *Psettodes belcheri* Bennett, a flatfish from the north-west coasts of Africa, and enormous heads of halibut from Newfoundland), which would have been extremely difficult, if not impossible, to procure otherwise.

When the specimen reaches the museum or laboratory it should be soaked in fresh water for just long enough for it to resume its natural form; after this, it can be finally immersed in alcohol or formalin. The complete elimination of the salt is quite unnecessary, since its presence does not harm the final preservation.

I have never experimented myself with a mixture of sodium chloride and sodium sulphate, although I understand that this has given excellent results.

Clearly, this method of salting does not represent the ideal treatment for histological examination, but I can assure you that, not only the external morphology, but even the macroscopic anatomy, is perfectly clear; external characters, bones, viscera, muscles and nerves can all be easily studied. Obviously, the same cannot be said with regard to the blood-vessels or the brain, since special treatment is usually required before undertaking research on these organs.

I do not pretend that the external shape of a salted fish will always compare favourably with that of one which has been placed while fresh in alcohol or formalin. The colours are altered; frequently the scales are displaced. Admittedly the salt is only a makeshift, but how very much better than putrefaction and complete ruin?

I have dealt only with fishes, but there is nothing to prevent the use of salt for the preservation of any kind of vertebrate, provided that such necessary precautions as cutting open the peritoneum and the stomach, etc., are taken.

[1] NATURE, 143, 455 (1939).

SEVENTY YEARS AGO

NATURE, vol. 1, March 10, 1870

Science Education in Germany

PROF. H. E. (afterwards Sir Henry) Roscoe, F.R.S., contributed a second article on this subject. The earlier article, dealing with the universities, appeared in NATURE of December 9, 1869; the present article deals with the "Polytechnic Schools".

"The 'Polytechnicum' is an institution peculiar to Modern Germany. It has for its object the teaching of all branches of the sciences of experiment and observation, not only in their principles, but in their applications to the industrial arts; these applications not being merely treated as illustrations of science, but regarded as the main subjects for instruction, for the sake of the understanding of which systematic courses on theoretic science are given."

The article points out that the polytechnics are quite independent of the science departments of the universities, although both are State institutions and there are often working arrangements between them. The professors rank somewhat below those of the universities. Entrance is normally at seventeen years of age, that is, one year earlier than to the universities.

The continued separation of the universities from the polytechnics is harmful in that it encourages the tendency in the polytechnics "to neglect the *educational* aspects of science in considering its practical applications".

A Probable Cause of Malaria

J. GAGLIARDI, writing under this title, refers to the work of Count Castracane on diatoms, described before the Academy of the Lincei. In this work, according to Gagliardi, he discovered that "nothing is so fatal to the life of marine or even brackish water diatoms as a sprinkling of pure fresh water. . . . From this fact he comes to the very probable conclusion that the sudden dying away of myriads of diatoms, besides, perhaps, myriads of other living creatures, during the rainy season might be, if not the only, at least one of the most efficient causes of *malaria*".

Natural Science Schools at Rugby

AN article appears, by the Rev. T. N. Hutchinson, on these new 'schools', which is accompanied by a plan and an engraving of a general view of the laboratory. The laboratory is 35 ft. × 22 ft., and intended to accommodate thirty boys. The benches are divided into compartments each of which includes a cupboard and two drawers, two shelves, two gas taps, sink and water supply. A room is provided for the lecturer, and the chemical lecture theatre seats fifty. The physics lecture theatre seats sixty.

M. DELAUNEY is the new director of the Paris Observatory. [See also NATURE, February 10, p. 235.]

PROF. UNGER, of Vienna, a well-known botanist, whose death we reported last week, was, it is now stated, found murdered in his bed at Graz; and no trace of the murderer has as yet been discovered. A priest has taken this opportunity to assert from the pulpit at Cilly, Styria, that the body of the late philosopher had probably been destroyed by the devil himself, who had just claims upon his soul!

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned

A MISTRESS OF METHOD for the Manchester Training College of Domestic Economy—The Director of Education, Education Offices, Deansgate, Manchester 3 (March 15).

LECTURER IN METALLURGY in the Technical College, Bradford—The Director of Education, Town Hall, Bradford (March 16).

HEADMASTER of the Skipton School of Art and the Skipton Technical Institute—The Secretary to the Managers, School of Science and Art, Skipton, Yorks (March 18).

WATERWORKS ENGINEER AND MANAGER—The Town Clerk, Municipal Buildings, Poole (March 20)

DIRECTOR OF EDUCATION—The Director of Education, Education Department, Newarke Street, Leicester (March 27).

DIRECTOR OF THE GEOLOGICAL SURVEY—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (April 12).

ASSISTANTS III for duty on Resident Technical Officer Staffs at Aircraft Construction Works—The Under-Secretary of State, Air Ministry (B 127), Department ZA, Harrogate, Yorks (quoting B.381).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Health Memo. Ev. 8 · Government Evacuation Scheme. Pp. 24. (London · H.M. Stationery Office.) 4*d* net. [152

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council, by H Dent Gardner; with Meteorological Notes and Tables for the Year 1939 with Mean Values for 65 Years (1871–1935), by W. Tregoning Hooper. Pp. 12 (Falmouth: Falmouth Observatory). [202

Committee of the Privy Council for Medical Research Report of the Medical Research Council for the Year 1938–1939. (Cmd. 6168.) Pp 171 (London · H M. Stationery Office) 3*s*. net. [212

Development Commission Twenty-ninth Report of the Development Commissioners, being for the Year ended the 31st March 1939. Pp. 133 (London: H.M. Stationery Office.) 2*s*. net. [212

The One Hundred and Sixth Annual Report of the Royal Cornwall Polytechnic Society New Series, Vol 9, Part 3, 1939 Pp. 102. (Falmouth · Royal Cornwall Polytechnic Society.) [222

The South-Eastern Naturalist and Antiquary: being the Forty-fourth Volume of Transactions of the South-Eastern Union of Scientific Societies, including the Proceedings at the Forty-fourth Annual Congress held at St. Albans, 1939. Pp lxvi+76 (London. South-Eastern Union of Scientific Societies.) 5*s*. net. [222

Other Countries

Kungl Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 18, No. 1. A New Anaspid from the Upper Devonian of Scaumenac Bay in Canada, with Remarks on the other Anaspids. By Erik A . son Stensiö. Pp. 25+1 plate. Serien 3, Band 18, No. 2: Paguriden und Galatheiden von Prof. Dr Sixten Bocks Expedition nach den Bonin-Inseln, 1914. Von Gustaf Melin. Pp. 119. Serien 3, Band 18, No. 3 · A Theory of Magnetic Storms and of the Aurora. By Hannes Alfvén. Pp. 39. Serien 3, Band 18, No. 4: Über die Calamitaceen-Gattung Dicalamophyllum Sterzel aus dem sächsischen Rotliegenden. Von Rudolf Florin. Pp. 18+3 plates. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [152

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 111: Rapport atlantique 1937–1938. Publié avec l'aide de Dr. Ed. Le Danois. Pp. 91 (Copenhague: Andr Fred. Høst et fils.) 5.00 kr. [202

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 198 · A Yield Analysis of Egyptian Wheats. By Dr. James Philp Pp. ii+22+5 plates. P.T. 3. Bulletin No. 199: A Spacing Experiment with Egyptian Wheats. By Dr. James Philp. Pp. ii+49+38 plates. P.T.10. Bulletin No. 202: A Comparative Test of the Yield of F_1 Hybrids between Inbred Lines of Maize. By Dr. James Philp. Pp. 6+2 plates. Mills. 15. Bulletin No. 222: The Quantity, Distribution and Composition of the Organic Matter and Available Nitrogen in Egyptian Soils. By David S. Gracie and Dr. Fahmy Khalil. Pp. vii+42. P.T. 5 Bulletin No. 229: Dibble-Sowing of Cotton—Method, Effects and Profits. By David S. Gracie and Dr. W. Lawrence Balls. Pp. ii+49+15 plates. P.T. 6. (Cairo: Government Press.) [202

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1939. Pp. iii+128. (Washington, D.C.: Government Printing Office) 15 cents. [202

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1938. Pp. viii+98. (Kingston: Government Printer.) [202

Anuario del Observatorio Astronómico de Madrid para 1939. Pp. 316. Anuario del Observatorio Astronómico de Madrid para 1940. Pp. 340. (Madrid: Instituto Geográfico.) [222

Egyptian Government: Ministry of Public Works. Annual Report, 1930–1931. Part 2. Pp. xiii+383+11 plates. (Cairo: Government Press.) P.T. 100. [222

Cawthron Institute. Monograph No. 2: Blow-flies (*Calliphoridae*) and their Associates in New Zealand. By Dr. David Miller. Pp. 68+8 plates. (Nelson: Cawthron Institute.) [222

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THE PLANNING OF RESEARCH

SOME time ago, Lord Chatfield gave a comprehensive account in the House of Lords, in reply to a question by Lord Strabolgi, of the organization of scientific knowledge and personnel in Great Britain in the prosecution of the country's war effort (NATURE, January 27, p. 134). Although speed of decision and action is vital in these days, it is perhaps as well that a fundamental question such as this should now be reviewed after an interval for reflection.

Broadly speaking, Lord Chatfield contended that the scientific talent of Great Britain is already mobilized to the best advantage. He pointed out that close contact exists between the civil directors of scientific research in the three Services, and urged that the professional ties of scientific workers who may be members of different departments would prevent departmentalism and facilitate the exchange of ideas Lord Chatfield also laid special stress on the value of an annual review of the research work in progress in the research departments of the three Services. Similarly, pointing out that there is no central organization or clearing house for research between the three fighting Services, he considered that the existing organization is adequate to ensure that an invention gets into the hands of the appropriate expert as quickly as possible and that central organization might impose delay.

Satisfactory as this reply may be in many respects, it does not really deal with the fundamental problems which are agitating the minds of scientific workers at the present time, and indeed on some points of detail it is possible to regard Lord Chatfield as too optimistic. The demands of secrecy imposed by war-time are a serious if inevitable obstacle to the exchange of ideas, at least beyond a certain stage of development—possibly the most important of all from the point of view of practice Moreover, there has already been a considerable curtailment of scientific meetings, which might well be rectified.

Lord Chatfield's reference to the annual review of Service research work and the dropping of long-range investigations which are not yielding immediate results, however advisable from a Service point of view particularly during war-time, touches on the first of the two major problems causing concern to scientific workers to-day. Already some science departments at the universities have adapted their research programmes in part to short-term problems which may soon be of urgent importance. In others, research has been interrupted or curtailed by transfer of staff or by requirements of the Services. In such circumstances, the problems of co-ordination between the various applied sciences and the integration of fundamental and applied research as a whole assume even greater importance. The progress of science and the needs of the present situation are daily widening the sphere of what must be regarded as practical research beyond the limits of present provisions

Accordingly, it is being asked whether the existing structure and machinery of research are adequate to serve the needs of the country, whether in time of peace or in war. Secondly, the place and function of the universities, not merely in relation to the organization or prosecution of research, but also to the national life, are the subject of equally anxious discussion. The two questions are interlocked in numerous ways: the relation between the teaching functions and research activities of the universities; the endowment of long-range research; questions of

professional training and training for leadership or citizenship, are all involved and in urgent need of attention.

To deal adequately with such major questions as these within the limits of a single article would be impossible, and for the moment our concern is chiefly with the adequacy of the present structure of research. This has been the subject of criticism in recent years, notably in the Memorandum on the Finance of Research prepared by the Parliamentary Science Committee, and by Prof J. D Bernal in "The Social Function of Science". More recently, it has been discussed by Dr. Bernard Lovell in "Science and Civilization" with the view of provoking further discussion

A preliminary analysis of academic research was presented at the Dundee meeting of the British Association in September last, and this analysis has been included in a recent broadsheet, "The Role of Research", issued by P E P (Political and Economic Planning) Even this preliminary survey makes clear the extreme difficulty of estimating with any accuracy the man-power engaged in academic research. Research staff on a full-time basis is not readily distinguished from staff engaged in part in lecturing or demonstrating, and great difficulties are also encountered even in defining a university institution, especially in the spheres of technology and technical training

An outstanding feature of this preliminary survey is its revelation of the insignificant provision made in universities in Great Britain for the study of descriptive and theoretical sociology While the group of social studies as a whole is well represented, the bulk both of its staff and students is found in departments of history, economics or law; contemporary social relations are scarcely studied from any point of view wider than that of economics. An excess in the proportion of advanced students over the percentage figure for the staff is most marked in departments of chemistry, but also appears in education, history and economics. The serious strain imposed on the teaching staffs by this disproportion cannot be without effect on their research time.

This preliminary survey thus supports the numerous pleas which have been voiced for some re-orientation of research effort between the physical sciences and the social and biological sciences. The unbalanced distribution of research resources even in war-time is likely to be fraught with serious consequences, to some of which attention has been directed from the economic side. The difficulties encountered in evacuation schemes have already indicated the need for more objective social research, and the success of rationing and other measures imposed by the national emergency may increasingly depend on accurate scientific knowledge of social needs and problems.

On this ground alone, therefore, inquiry into the present structure of research appears to be justified. It is not disputed, as Lord Chatfield urged, and as Sir Robert Robertson observed when the B.A. report was presented at Dundee, that effective machinery of co-operation exists in the Advisory Council for Scientific and Industrial Research, the Agricultural Research Council and the Medical Research Council The improvement in this respect in the last twenty years is entirely satisfactory. What is unsatisfactory, however, is the inadequacy of the resources available for such bodies, and their limitation to advisory functions as distinct from the initiation of policy. Dr. Lovell contrasts, for example, the £195,000 received by the Medical Research Council for research with the £3,000,000 spent every year on advertising patent medicines and the annual turnover of £20,000,000 from their sale.

A second unsatisfactory feature of the situation is the absence of a co-ordinating authority able or competent to divert available expenditure or resources from one major field to another as the need is demonstrated. Despite the established value of long-range research in providing the basis of technical advance, such fundamental research remains in the most precarious position of all. Its efficiency depends on continuity, and yet it is probably more liable to abrupt termination or interruption than any other type. The importance of provision for continuity, which is the only satisfactory guarantee that half-completed work may not be utterly wasted, can scarcely be overstressed. Something much more effective than the existing methods of co-operation is essential to initiate the rationalization necessary to bring the whole cycle of research into a comprehensive and ordered scheme.

Failure to realize the basic interdependence of research—that research, whether prosecuted in the universities, in industry or in Government departments, is not distinct but a part of the same mechanism—not only threatens to handicap the solution of problems of reconstruction in time of peace, but is also a real danger to the efficiency of our war-effort. Already it is clear that many of our difficulties in dealing with the problems of adjustment from a peace-time to a war-time economy

are due to our past neglect of research in the social and biological sciences. Many aspects of administration and government, the directive part of man and most aspects of human values are largely untouched by scientific investigation.

It is this position which makes Lord Chatfield's account of consultation and contact between the different Service departments less reassuring than it might otherwise be. Even if there were a co-ordinating authority competent to sort out long-range investigations, discontinued as a result of the annual review of the Service departments, and ensure their continuity where desirable, we could not regard the position as satisfactory while there appears to be no means for initiating those researches on the social side, which may well have a decisive influence on national morale. It has to be remembered in this connexion that there is already a marked tendency in industry, for example, to ignore the lessons of the War of 1914–18 and the experience of the Industrial Health Research Board, as was pointed out at a recent symposium of the Industrial Section of the British Psychological Society (see NATURE, February 3, 1940, p. 174).

In comparison with the position during the War of 1914–18, the organization of research, of course, represents an immense advance. The Advisory Council of the Department of Scientific and Industrial Research is very clearly alive to the danger of interrupting research, and has already deprecated any hasty reduction of work by the research associations without careful consideration of its ultimate effect on the welfare of the industries they serve. While wise adjustment of research programmes may enable the various associations to anticipate and deal with problems requiring immediate solution, the Advisory Council is anxious that fundamental investigations should be continued so far as possible. The Government, moreover, is to continue its pre-War rate of grants.

Satisfactory as this position may be, the crux of the situation is in the universities, where by far the greater proportion of fundamental research is prosecuted. Apart from the ill-defined relation between teaching and research, there is considerable waste of time on routine constructional work owing to the absence of technical assistants and mechanics. This waste has not been recognized by the authorities, and in war-time the demands of munition work and other forms of national service are likely to accentuate the evil by increasing the already acute shortage of qualified assistants.

The fundamental problem of university research is, however, that of widening the front of scientific advance, and while preserving the independence of the research worker and avoiding any regimentation, of securing that the resources available are adequately distributed over the whole field of science, and particularly those branches of knowledge where fundamental advance is most urgently demanded to meet the needs of the nation. Some strategy of scientific advance is imperative if resources are to be maintained unimpaired under peace-time conditions; if they are attenuated in war, it may make all the difference between victory and defeat.

The first steps to some such co-ordinated strategy must come from within the ranks of scientific men themselves. It is a matter which concerns all classes of scientific workers, however effectively some of the stronger groups, such as the chemists, might contribute through their professional organizations to the removal of particular handicaps on efficiency. Through the Royal Society or the new Division for the Social and International Relations of Science of the British Association, something of a plan of advance should be elaborated, taking account of existing gaps in the front of science, the border-line territories which are apt to be neglected and the manifold needs of a society at war and of the reconstruction to follow. Only with such a broad plan as basis will it be possible to compute the effort required, and the extent to which existing resources must be supplemented or diverted.

Given such a plan, some type of executive authority and scientific General Staff will be required to carry it out. The nucleus should not be hard to find in the Advisory Council on Scientific Research and Technical Development and existing organizations. Here, however, as on the economic front, the primary need is for vision and drive. It is only when scientific workers themselves realize the immense possibilities in their hands that we can hope for the elaboration and execution of that plan. From them must come the pressure on their individual societies and associations for the formulation of a common policy, and the resolute attack on all forms of inefficiency and waste in scientific research, and on obstacles to its development. On them individually, too, must rest a large share of the responsibility for making both the Government and the public realize the value of the contribution which science could make and the means by which that effort should be organized and directed.

PRINCIPLES IN PHYSICAL SCIENCE AND FREE WILL

The Philosophy of Physical Science
(Tarner Lectures, 1938.) By Sir Arthur Eddington. Pp. ix + 230 (Cambridge: At the University Press, 1939.) 8*s*. 6*d* net

THE following process is recurrent in physical science. A certain amount of special knowledge, empirically accumulated and assorted, is tentatively cast into a comprehensive theoretical aspect The theory, after having been gradually corrected by further experiments and after having created several new appropriate definitions, tends to acquire an unforeseen general validity. But, strangely enough, at the same time, when it has become an inalienable requisite for the orientation of all future experimental and theoretical research, the knowledge which its propositions are supposed to convey turns out to be more and more tautological.

Withdrawn from the action of forces, a body moves uniformly in a straight line; with a force acting on the body, there is a rate of increase of speed, proportional to the force. These laws were originally abstracted from empirical findings. Subsequent generalization turned them into the tautological assertion that a body moves uniformly in a straight line unless it does not, in which latter case the force is to be judged by the body's acceleration An appropriate definition points out the relevant notion by giving it a name of its own (force). What is left of the law is the important hint: In mechanical problems, pray, pay primary attention to the *second* derivatives—it is *they* which matter

The example is old-fashioned and would need re-modelling to-day, but it is simple and sufficiently illustrative. The three laws of thermodynamics (principle of energy, principle of entropy, Nernst's theorem) have acquired almost a similar standing Though they are not tautological, it would seem a rather hypocritical broadmindedness to maintain that they are empirical regularities only and could be contradicted by experiment at any time. I should not venture to oppose a view which in these and similar cases (for example, that of the special theory of relativity) went so far to the other extreme as to hold that the content of the theory had been switched over—intentionally or inadvertently—from empirical regularities to essential ingredients of our method of attack on problems of physical science, and had thereby been both deprived of the benefit and withdrawn from the danger of being checked by experiment.

The book under review goes further than that. It is said that recent advance in physical science has made us aware of the epistemological method, which consists in "examining the sensory and intellectual equipment used in observation" (p.18), and allows us to reach at least some of the fundamental laws of physics with "a security which is denied to those that can only be reached empirically" (p 19) After the "replacement of physical hypotheses by epistemological principles" (p. 45), those laws turn out to be "compulsory and universal" (p. 45) This is "the equipment to put theoretical physics on a surer footing than it formerly aspired to" (p. 21).

Both views—that which I said I would not venture to oppose and Eddington's—claim the subjective character of certain fundamental laws The peculiar brand of Eddington's subjectivism is best revealed by his incidental criticism of H. Poincaré's famous statement concerning geometry (p. 72) According to Poincaré, we can never decide by experiment which geometry is the right one, because any one will do, provided that the laws of physics to go with it are appropriately chosen But they are functions of the geometry. We naturally, yet arbitrarily, decide for that geometry which gives our description of physical Nature the simplest form. It is thus not the "true" one, but the *comfortable* one, says Poincaré If Eddington pointed out that, according to present knowledge, spherical geometry (with slight deviations for the local gravitational fields) was the only one not to entail an intolerable amount of inconvenience, I should agree. But, drawing on a quotation from "Science et Hypothèse" which, I confess, is a little daring and slightly over-stated, he declares that experiment, theory and epistemological research have definitely set an end to the happy-go-lucky times when we could allow a pure mathematician his extravagant dream of liberty to choose which geometry he liked.

I am probably not the only one who has always looked upon Poincaré's thesis as one of the most important revelations—and a genuinely relativistic one, at that. I consider it to be irrefutable and claim the same liberty of choice with respect to all those fundamental laws of physics (or constituents or features thereof) to which a purely subjective standing is duly attributed at any stage of the development of science. But the ease and simplicity of our description of Nature (or, if that is preferred, of our comprehensive report on our physical knowledge) is a function of our choice, showing usually a tremendous, almost selective,

maximum for a particular choice. This is what determines the latter. As for the rest of the laws, I am not keen on calling them objective and anchoring them in an "objectively existing Universe" (which Eddington rejects). The *external world*, which he willingly grants (p. 209, p. 216), suffices for that purpose

Another question of primary importance has received much attention, ever since the indeterminist view of quantum mechanics made its appearance in physics. Does the gap left in the predictability of events leave room for conscious volition to have its share in determining them? I cannot help being bewildered by the author's comments on this question. In the first place, he finds the limits of uncertainty left by Heisenberg's principle somewhat narrow for volition to get its proper share. He therefore pulls them down, claiming a *correlated behaviour* of the particles in, at least, some parts of brain-matter (p. 183) But Heisenberg's principle is supposed to be of epistemological origin (p. 99, p. 183) and therefore (p. 181) to hold also for brain-matter! Secondly, any kind of correlated behaviour or "demonic influence", whether outside the Heisenberg limits or within them, is bound to violate the second law of thermodynamics If that is the meaning (and I am afraid it is), then the soothing statement (p 181) about the "obedience of brain matter to the fundamental laws of physics which, being of epistemological origin, are compulsory for all matter", is grievously impoverished by the absence of a comma before "which". This is not the place to dwell upon my personal view, in which the alleged antithesis between rigid causality and free will is an illusion and the attempts to bridge it go so far astray as an attempt to explain the behaviour of an atom by its hunger or joy. But quite apart from this, say, prejudice of mine, I have always failed to appreciate the satisfaction felt about the gap which quantum mechanics is supposed to have opened for the purpose. The suggestion might be worth considering, if it succeeded without any exceptional law altogether. But there is actually no gap for volition to creep in, unless we are prepared, in certain exceptional areas, to sacrifice the Second Law. I do not consider that to be better or worse than it would have been thirty years ago, to abolish determinism in those areas

There is still one question which I cannot repress: What is the source of the knowledge (p. 218) that "matter is normally unassociated with consciousness"? That a being organized much the same way as myself has likewise consciousness is a natural inference. But can it be inverted? Is not a certain likeness in organization the necessary condition for becoming aware of the fact? How should a galaxy, if it were associated with consciousness, and a human being communicate? The idea is that of G. Th. Fechner

By not repressing my criticism of an author whom I deeply admire, I hope that I have, at least, conveyed to the reader how fascinating and stirring this book is from the first to the last page. There are many chapters upon which I could not comment at all—perhaps the most interesting ones. No man of science should miss reading the book. But with a work of Eddington's these are truisms. I propose to take a phrase on p 113 as a motto for the whole—in spite of the author, who would certainly disagree. It reads: "I have been acting as an advocate for an extreme view, presuming that your natural prejudices are all the other way."

E. SCHRODINGER.

TALKS ABOUT GARDENING

Science Lends a Hand in the Garden
By Sir Frederick Keeble. Pp. xi+307. (London: Putnam and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THE leading articles in the weekly publication, the *Gardeners' Chronicle*, are frequently concerned with the application of recent scientific investigations to garden practice. A considerable number of these articles written by Sir Frederick Keeble are now brought together, carefully arranged and published in book form. The author states in the preface: "This book contains what are really talks about gardening——" "They don't set out to teach, but only to let gardeners know what people are gradually learning about plants and the soil they live in." The author certainly succeeds "In writing these things in the simplest possible way".

It is not feasible to direct attention to all the topics discussed; mention of but few must here suffice. The earlier chapters concern soil factors, fertilizers, and the humus content of soil and composts; a chapter is devoted to fruit, in which rootstocks, ripening and storage are discussed. Various environmental factors influencing the growth of garden plants are considered, and several pages are devoted to newly reported diseases and remedial measures; the production of new

varieties by plant-breeding forms the subject matter of another chapter.

Many worthy garden plants are mentioned and there are hints on their cultivation and methods of pruning, together with brief descriptions of the peculiarities of some of these plants. The author has briefly drawn upon his wide experience in recommending some of the best shrubs

The text reads easily, the charming literary style of Sir Frederick may gently persuade or beguile the reader to attempt more than "A chapter at a time" as is modestly suggested in the preface When bringing to the reader's notice the results of recent research the author facilitates reference to the original work but does not quote fully 'chapter and verse'. There is an adequate index, but the book is without illustrations. A number of good photographs will always attract the keen amateur and general reader.

This book forms a general introduction to, and a brief review of, the progress made in applied botany (other than systematic studies), and is suitable for the general reader It should interest botanists generally as it indicates many attractive problems yet to be solved. Few gardeners will fail to grasp the hand that science lends, and many amateurs will be grateful for the introduction so effected

THE FUNCTION OF THE ADRENAL CORTEX

Die Funktion der Nebennierenrinde
Von Prof F Verzár Pp 266 + 4 plates. (Basel: Benno Schwabe und Co., 1939) 25 Schw. francs.

VERZÁR, from whose laboratory have come many contributions to the knowledge of the function of the adrenal cortex, has published an extremely interesting monograph on this subject. A bibliography of more than 1,500 references is included, about 1,100 of which are from the last ten, and about 550 from the last three years This illustrates the rapid progress recently made in the knowledge of this organ of which, as Verzár states, until a few years ago little was known except the fact that it is indispensable to life. Verzár gives a vivid impression of the rapidity of this progress when he describes, in the chapter on the chemistry of the cortical hormone, how the important contributions from three laboratories, from that of Kendall in Rochester, of Reichstein in Zurich and of Winterstein in New York, followed one another sometimes at less than monthly intervals

In the early chapters the different methods are reviewed for removing the adrenals and for assaying the cortical hormone, and the history of its chemistry and identification is told The last third of the book is concerned mainly with the conditions of hypertrophy and atrophy of the cortex, with its relation to other endocrine organs and with clinical observations The material is well reviewed, and new suggestions are put forward. Some of the disturbances in the carbohydrate, fat, and ketone metabolism which develop after removal of the pituitary body can be restored to a great extent by cortin and may be regarded as signs of insufficiency of the adrenal cortex, which becomes atrophic after the operation. A detailed account is given of the morphological, chemical and experimental basis for the theory of production of sex hormones from the adrenal cortex under normal and abnormal conditions.

The main interest, however, centres around those chapters (vi to xv and xxii) dealing with cortical insufficiency and the functions of the cortical hormone. According to Verzár, it acts on the cell metabolism, enabling the processes of phosphorylation to take place in the cells Lack of the hormone leads to impairment of phosphorylation in the organism, and the symptomatology of cortical insufficiency may be regarded mainly as the direct or indirect outcome of this disturbance. The starting point for this conception was a comparison of cortical insufficiency with iodo-acetic acid poisoning in which phosphorylation is impaired Verzár was struck by the similarity existing between the two conditions, and the comparison has been the guide in the development of his theory

The most conspicuous sign of cortical insufficiency is muscular weakness. The contraction curves from adynamic muscles resemble those obtained from muscles poisoned with iodo-acetic acid. According to Verzár, absence of cortical hormone, like iodo-acetic acid poisoning, affects the chemical processes of restitution in muscle which are associated with lactic acid formation. Numerous experiments are quoted showing the disturbance in lactic acid formation and in the whole carbohydrate metabolism In adrenalectomized rats the disappearance of injected lactic acid is slowed down, the oxygen consumption and the carbon dioxide output are only slightly increased during exercise, which is attributed to impairment of lactic acid formation, there is only a slight increase in the lactic acid concentration of indirectly

stimulated muscles, formation of glycogen is impaired, liver and muscle glycogen are low and the blood sugar, therefore, has a tendency to fall during exercise

Verzár's analysis of these metabolic changes started by studying the absorption of sugars from the intestine In adrenalectomized rats as well as after iodo-acetic acid poisoning, the selective absorption of glucose and galactose was found to be inhibited. The selective absorption is attributed to phosphorylation of these sugars in the intestinal epithelium, and the cortical hormone is to bring about this reaction not only in the intestinal epithelium but also generally in all cells. In this way the changes in the carbohydrate metabolism during cortical insufficiency are explained The theory is further made responsible for explaining changes in salt and water metabolism Phosphorylation is also thought to be the key to the changes in fat metabolism In adrenalectomized animals and in iodo-acetic acid poisoning the development of fatty livers after different forms of treatment is prevented and the fat absorption from the intestine is inhibited. This is explained by inhibition of fat synthesis in the epithelium due to impairment of phosphorylation, in this case of the phosphatides

Another interesting outlook is the relation of the action of the cortical hormone to enzymes and vitamins, particularly those of the B group The respiratory enzyme of Warburg contains as prosthetic group vitamin B_2 (lactoflavin or riboflavin) which is phosphorylated and linked to the protein According to Verzár the cortical hormone enables the phosphorylation to take place, and lack of cortin results in the inability of phosphorylating riboflavin In adrenalectomized rats and in iodo-acetic acid poisoning the growth ceased, it could be restored by flavin phosphoric acid but not by riboflavin In further experiments on adrenalectomized animals the ratio between free and bound lactoflavin was found to be reduced from 1 : 10 to 1 · 1 It is assumed that the phosphorylation of vitamin B_1 to cocarboxylase is also impaired during cortical insufficiency. Recent experiments, however, of Ochoa and Rossiter (*J. Physiol*, **97**, 1P) "offer no evidence for the theory that the adrenal cortical hormone is necessary for the phosphorylation of vitamin B_1".

In the concluding chapter a diagrammatic representation is given of the changes occurring in cortical insufficiency to illustrate how they all, those of carbohydrate, fat, sodium, potassium and water metabolism, may be traced back to impairment of the one basal factor of cellular metabolism, phosphorylation

We may be grateful to Verzár for having given us such a clear and detailed account of his attractive theory, the ultimate value of which remains to be decided by future experiments His results have to be confirmed and new experiments carried out before the theory will be generally accepted

W FELDBERG.

ECONOMIC ENTOMOLOGY

Destructive and Useful Insects

Their Habits and Control By Prof C. L. Metcalf and W P Flint (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. xvi + 981 (New York and London: McGraw-Hill Book Co., Inc, 1939.) 50*s*.

THIS second edition is a comprehensive work intended for the student of entomology as well as for the practical man in the agricultural or veterinary field. It is conveniently arranged to this end.

The first third of the book includes a generalized treatment of the importance of insects to man together with a simplified account of the morphology, physiology and development of these animals. The physiology of insects has been described as the handmaid of economic entomology, and one would have preferred this part to have been enlarged and brought into closer reference with the later economic sections. In these pages, too, is an account of the principles of insect control with the stress on practical rather than academic aspects.

The rest of the volume is concerned with accounts of some 370 pests—agricultural, veterinary and medical—and the practical man to whom these pages will appeal is provided with helpful keys and descriptions for their identification

New features of value in this edition are the cross-references given to those insects whose damage lies in more directions than one, the keys for the identification of young as well as adult stages and the additional matter relating to modern aspects of chemical control.

The book contains a wealth of valuable practical information. Omissions are, however, inevitable. For example, the Aphidæ are credited with doing no more damage than that caused by robbing the host plants of fluid, and no mention is made of the conjunctivitis fly, *Hippelates pusio* of California, which is within the area covered by this book.

Following a discussion on page 161 on the need for scientific names instead of 'nicknames', it is remarkable that each species is recorded under its 'nickname' in bold type, the scientific name being relegated to a footnote and in some cases omitted altogether, as on p. 483.

The book is copiously illustrated by clear figures, though some of these have suffered in reproduction. It is carefully indexed and well printed and deserves a good reception, especially from all students of entomology in the United States and southern Canada, the area which it is intended to serve.

L. E.

MOLECULAR STRUCTURE AND RAMAN SPECTROSCOPY

The Raman Effect and its Chemical Applications By James H Hibben With a Theoretical Discussion by James H Hibben and Prof Edward Teller. (American Chemical Society, Monograph Series, No 80.) Pp 544 (New York: Reinhold Publishing Corporation; London Chapman and Hall, Ltd, 1939) 66s net

MODERN students of molecular structure have before them the double objective of the determination of the positions and mobilities of the atoms in a molecule, or, in other words, the equilibrium atomic configuration and the intramolecular force field, and their ideal is to achieve a complete and quantitative description of these complementary features of structure Two types of method of outstanding value are available for the quantitative study of atomic configuration, namely, a group of interferometric methods, either with electrons or X-rays, and a group of spectroscopic methods, which may be summarized under the name long-wave spectroscopy One method only is available for the complementary study of intramolecular force fields, namely, the method of long-wave spectroscopy

In long-wave spectroscopy the immediate object is to observe rotational and vibrational frequencies: the former are parameters for atomic configuration, the latter for both atomic configuration and intramolecular forces Prior to 1928 the only direct method of observing such frequencies was by the study of absorption in the infra-red region of the spectrum, but with the recognition of the Raman effect, that is, that a rotating or vibrating molecule, when scattering light, may change its frequency by the frequency of the rotation or vibration, a second direct method became available One advantage of the new method, its much simpler technique, was immediately appreciated, and observations of frequencies began to be added to the records at a rate never achieved by the method of infra-red spectroscopy.

As the theory of light scattering became better understood, it appeared that a second, and still more important, factor contributed to the value of Raman spectroscopy. For many molecules certain vibrations exist which cannot in principle record their fundamental frequencies in the infra-red spectrum It is usually true for the same molecules that certain of their vibrations will not exhibit their fundamental frequencies in the Raman spectrum. However, the rules which govern the exclusion of frequencies from the two spectra are different, so that, by examination of both spectra, it may be possible to obtain a complete set of molecular vibration frequencies; and it will almost always be possible to obtain a more complete set than would have resulted from the application of either method separately. the two methods are complementary.

Dr. Hibben has now produced a book which may be regarded as a complete manual of Raman spectroscopy, alike from the points of view of experiment and theory. The work opens with a description of apparatus and a summary of all the information necessary to anyone who, without previous experience, wishes to make measurements. There follow four chapters, written in collaboration with Dr. E. Teller, on the theory of molecular vibrations and rotations, the theory of infra-red and of Raman spectra, of the vibrations and force systems characterizing molecules of particular types, and of factors such as isotopic substitution which modify spectra in predictable ways. This section is written with great clarity, and is, indeed, a striking example of the achievement of simplicity without loss of precision in a mathematico-physical subject. A good example of this is the product rule, which is derived and fully explained on a single page with the aid of only three formulæ. In the chapter on the vibrations of particular molecules, an effort seems to have been made to include all the formulæ likely to be useful to anyone wishing to calculate the force systems of simple molecules from the observed frequencies.

The chapter on isotopic substitution brings out the enormous advantage which this device confers on vibrational spectroscopy. Before 1935 there was no general method of passing rigorously from observations (frequencies) to ultimate conclusions

(force fields) by the route

$$\text{Frequencies}\rightarrow\left\{\begin{array}{l}\text{Equilibrium configuration}\\ \\ \left.\begin{array}{l}\text{Vibration forms}\\ \text{(assigned to the}\\ \text{frequencies).}\end{array}\right\}\rightarrow\text{Force system,}\end{array}\right.$$

because, in the first place, there was no definite, quantitative test to confirm a configuration, and an assignment of its vibration forms, assumed as the interpretation of an observed set of frequencies; and, because, secondly, with a correct molecular model and a correct assignment, the number of frequencies was, for all but the very simplest molecules, smaller than the number of parameters needed to specify the force field. The method of isotopic substitution overcomes both difficulties, because the product rule, applied to the frequencies of isotopically related molecules, provides a test for any assumed model and any assignment of its vibration forms; and because by measuring the frequencies of a sufficient number of isotopically related molecules it is possible, in principle at least, to obtain a sufficient number of frequencies fully to specify the common force system.

The last three quarters of the book contain an exhaustive summary of the observations of Raman spectra over the whole field of organic and inorganic chemistry. Special points of physical or chemical significance are discussed in passing, and the text is illustrated with many interesting microphotometric traces of Raman spectra. These brief discussions will doubtless stimulate much research; indeed it is impossible to read five pages anywhere in this part of the book without wishing to investigate some question. A highly valuable feature is the bibliography and index of compounds, which together constitute a complete guide to the literature of the Raman effect. Heavy labour must have been expended on this compilation, but, writing so complete a work, the author has rendered a signal service to science, and to all interested in the subject of molecular vibrations

C. K INGOLD.

HISTORY OF LIGHTING APPLIANCES

The Story of the Lamp (and the Candle)
By F. W. Robins. Pp xiv + 156 + 28 plates. (London, New York and Toronto: Oxford University Press, 1939.) 15s net

IT is surprising that such a commonplace subject as that of lighting appliances should be so poorly documented There are plenty of references for those who have the time to find them, and there is always Hough's scholarly catalogue published some years ago as *Smithsonian Bulletin* No. 141. For the mechanical era, which title applies only to the last hundred years or so, there is a comprehensive account of earlier devices entitled "Chemical Technology", volumes 2 and 3, by Groves and Thorpe and published in 1895 by J. and A. Churchill, while for the present century information is not difficult to obtain.

In the volume under review, Mr. Robins has made an attempt to provide a treatise in which the subject shall be dealt with in some detail, and at the same time provide interesting reading as a narrative. The attempt has not been unsuccessful, although there are certain limitations such as the condensation of the final century, when illuminating power rose steeply, to a sketchy account of ten pages.

In the 5,000 years preceding Argand's invention of his doubly aerated burner, there was little improvement over the illuminating power of the lamps devised in Sumerian times; but of lamps, candles and torches there were so many forms and independent origins that it has taken a considerable degree of skill to weld the history into a readable form

The author, in obtaining the material for his book, has acquired a noteworthy private collection, of which some five hundred items are illustrated in the twenty-seven plates. Errors of fact are few, but occasionally there is evidence of the inevitable pitfalls of over-compression normal to the presentation of such a wide subject. Thus on page 21, the author boldly refers to the first American discovery of petroleum as having occurred in the year 1859, when the Pennsylvania wells were opened, whereas d'Allion, writing in 1629, recorded its use medicinally by the Indians, and there were many other records in the intervening years.

In the "Prologue" the author expresses the hope that the book will be a substantial nucleus to which additions may be made, and in particular there is a reference to the ethnological significance of lighting developments which appears not fully to have been explored.

It is to be hoped that this treatise may provide the stimulus for a fuller investigation of the influence of the lamp and candle on contemporary developments, and that the work which Mr. Robins has begun will lead to extensive research in a field which is at present most inadequately explored.

W. T. O'D.

HISTORY OF THE VACUUM FLASK*

By SIR WILLIAM BRAGG, O.M, K.B.E., PRES. R.S.

FEW laboratory devices have achieved the popularity of the vacuum flask. Since Sir James Dewar designed it for the purpose of preventing his liquid air from rapid evaporation, the flask has become a household friend and an invaluable tool in the laboratory and the workshop. It is so very simple and yet so very efficient Each of the ways by which heat can pass from place to place, by convection, by conduction and by radiation, is almost entirely blocked, with the result that everyone knows

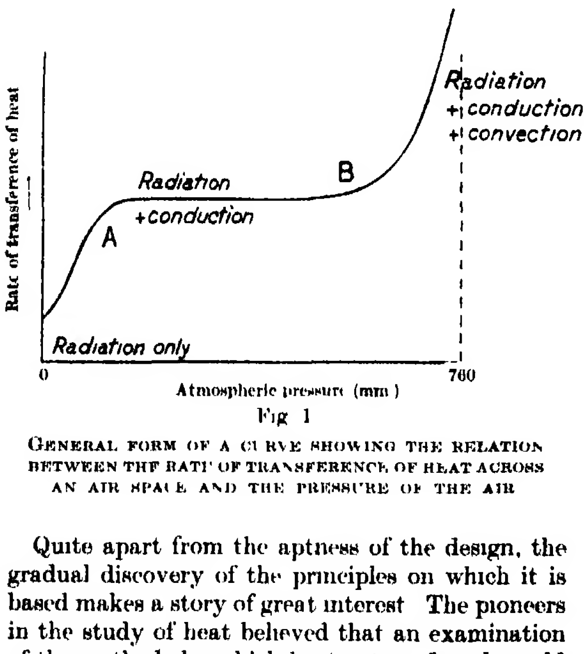


Fig 1

GENERAL FORM OF A CURVE SHOWING THE RELATION BETWEEN THE RATE OF TRANSFERENCE OF HEAT ACROSS AN AIR SPACE AND THE PRESSURE OF THE AIR

Quite apart from the aptness of the design, the gradual discovery of the principles on which it is based makes a story of great interest The pioneers in the study of heat believed that an examination of the methods by which heat is transferred would offer the best chances of discovering the nature of heat itself. Consequently their experiments were remarkable in themselves, and moreover, their interpretations of what they observed throw a curious light on the workings of their minds as they tried to establish one or other of the widely differing theories then held

Thus Rumford in 1785 hung a thermometer by a thread in a closed vessel and set out to find whether or no heat was helped or hindered on its way to the thermometer by the air through which it must pass He expected to find that removal of the air would hasten the transference of heat, because he believed that heat was associated with motion, and that the transference was effected by a wave motion in a medium which could not be evacuated The air in his vessel would not on that theory be the actual carrier of the heat and might well be a hindrance He formed a Torricellian vacuum in his vessel by first filling it with mercury, which was heated to drive off any attached air, and then draining it in the usual way It then appeared that the transference was less rapid than when the vessel contained air at atmospheric pressure This may not have been what he expected, but nevertheless it favoured his theory because it seemed to show that heat could cross a space void of air. As a matter of fact, there must have been enough air left to be important, but he could not have known that. His critics, whom we may take to be represented by Leslie—whose experiments will be described later—supposed that air was alone responsible for the transfer and refused to believe that heat could cross a vacuum

As we know now, the relation between the flow of heat across any space and the pressure of the gas in that space can be represented by a curve of which the general form is shown in Fig 1

The positions of the bends at *A* and *B* and the dimensions of the curve depend on the form of the experimental vessel, the condition of its walls and the nature of the gas which it contains. If the emitting and the absorbing surfaces within a vessel are small compared with the dimensions of the vessel, convection will play a large part unless the pressure is small, and the bend at *B* will then be far to the left of the figure. If convection is not serious, a long level stretch from *B* to *A* will show that the conduction is independent of pressure—as Maxwell proved—until at *A* the free path of the molecules becomes comparable with the dimensions of the vessel If evacuation passes this point, conduction rapidly ceases and radiation acts alone.

Rumford's vacuum was good enough to take him some way round the corner at *A*, but he could not have known how far he had yet to go. Air was still doing most of the work. He may perhaps have reduced the pressure to a tenth of a millimetre.

A little later (1798), Rumford carried out his famous experiment of the generation of heat during

* Substance of lectures at the Royal Institution delivered on December 7 and 14.

the boring of a cannon. About the same time he compared with great care the weight of a mass of water when hot and when cold and, finding no difference, placed the result to the credit of the 'motion' theory The supporters of the theory that heat was a form of fluid were by no means impressed by all these arguments Davy and Young supported him, but they were very much in the minority. Leslie was an energetic opponent. "In the infancy of science", wrote Leslie ('An Enquiry into the Nature of Heat", p. 139 (1804)), "heat was supposed to consist in certain intestine vibrations". He had not changed his mind when he wrote "Dissertation Fourth" prefixed to the seventh edition of the "Encyclopædia Britannica" (1820).

Leslie supposed that light traversed space in material form and entered into some kind of combination with the matter of any body on which it fell, in that way heat was produced Heat itself, as such, could not cross a vacuum The transfer of heat across an air space was accomplished through the simultaneous agencies of air pulses and of air jets directed from the hot body Herschel in 1800 showed that a thermometer when placed in the spectrum and also when placed well outside the red end of the spectrum showed the receipt of heat without the agency of light. It was then asserted that his experimental arrangements were at fault. "This bold hypothesis was for a time regarded with wonder and applause but the delicate observations of Berard soon demolished the fabric. The notion of dark rays of light which enveloped the science in mystery stands now therefore without any proof and is utterly discountenanced by sound philosophy" ("Dissertation Fourth", p. 636) Herschel's own interpretation of his experiment is very interesting He supposed that there were two forms of radiation, one constituting light and the other heat, and that they overlapped "Those who would have the rays of heat do also the office of light must be obliged to maintain the following arbitrary and revolting proposition : viz., that a set of rays conveying heat should all at once in a certain part of the spectrum begin to give a small degree of light" (*Phil. Trans. Roy. Soc.*, **90**, 508). If this attitude seems surprising to us, we may well remember that we are less inclined in these days to consider our natural senses to be the perfect overriding judges of natural effects. Herschel would think that light and eyes were made for each other, that the intensity of light in different parts of the spectrum both as sensation and as cause of sensation was what the eye could see there, and that it was "revolting" to suppose that there was something of the same nature as light which the eye could not see.

Since Rumford made these first experiments, a number of workers have examined the passage of heat across a gas-filled space, not with Rumford's purpose of discovering whether air is necessary, but as tests of theories connecting amounts of transference with difference of temperature Dulong and Petit did not use a high vacuum, they speak of 2 mm mercury as being usual (*Ann. Chim Phys.*, **7**, 245, 1817), so that their evacuation cannot have taken them round the corner at *A* In 1875 Kundt and Warburg (*Pogg Ann*, **156**, 177, 1875) carried the experiment to the limit. They had good pumps and they cooked their containing vessels so as to drive off gases adhering to the walls, a procedure which they found to be absolutely necessary As they arrived at the same figure for the transference no matter whether air, hydrogen or carbon dioxide had been in their vessel before evacuation, the last traces of gas must have been gone before the measurements were made The remaining transference must have been due to radiation alone : in their case it was of the order of the fourth or the fifth of the amount when the vessel was full of gas, but of course this figure has no absolute meaning since it depends on the conditions of the experiment

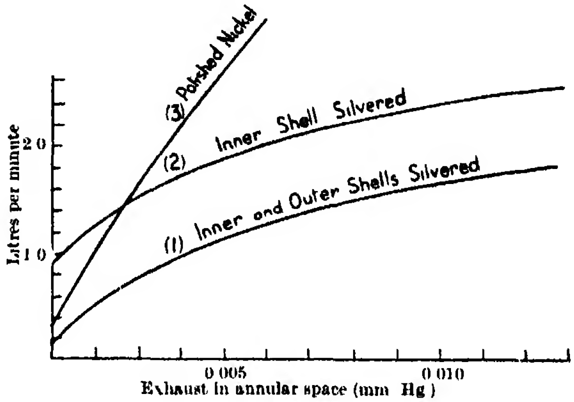


Fig. 2.

THIS FIGURE IS TAKEN FROM DEWAR'S PAPERS, VOL 2, P 1265 IT SHOWS THE RELATION BETWEEN THE AIR PRESSURE IN THE ANNULAR SPACE OF A VACUUM FLASK AND THE LEAKAGE OF HEAT MEASURED BY THE AMOUNT OF LIQUID AIR EVAPORATED FROM THE INNER VESSEL THE AIR PRESSURE IS VERY LOW, SO THAT THE EFFECTS OF RADIATION ARE CLEARLY SHOWN.

When Dewar began to construct his vacuum vessels, he also found that the greatest care must be taken to remove the last traces of gas : very often the vessels had to be kept in the heated oven for many days.

The next feature of the vacuum flask to be considered is the silvering of the walls bordering

on the evacuated space. In the early days, to which I have already referred, the connexion between the amount of radiation emitted or absorbed and the surface of the emitter or absorber was also a subject of interest, because, as already said, it might be expected to give information as to the nature of heat. Rumford and Leslie made experiments in this field, those of the latter being perhaps the best known. Their methods were similar, and their results also. Both used a 'thermoscope' resembling the earlier instrument which Leslie had made for his studies in hygrometry Leslie's results were published in March 1804 in his "Inquiry into the Nature of Heat": Rumford's results were published in various places, some of them, for example, in the *Transactions of the Royal Society* in January 1804.

The two authors were probably unaware of each other's work and their publications may be considered to be simultaneous Their interpretations were, of course, poles apart. Leslie supposed that metal surfaces reflected well, but emitted or absorbed badly because there was a layer of air in a special condition next all surfaces across which heat pulses could not pass, and that this was narrow in the case of non-metallic surfaces but wide in the case of metals unless the surface was roughened, in which case the peaks projected into the outer air Rumford did not attempt such an intimate explanation, but merely recorded his results in terms of vibratory motion He made one interesting mistake He ascribed a definite frequency to each temperature, not in the modern sense that for each temperature there is a range of frequencies of which that existing in greatest intensity is characteristic of the temperature, but on the assumption that for each temperature there was one frequency only. When a hot body A radiated to a cold body B, the former emitted rays of a higher frequency which were "calorific" to B and B emitted rays of lower frequency which were "frigorific" to A Rumford was further in error in supposing that fluids did not conduct heat; he was misled by the magnitude of the part played by convection and missed the relatively small part played by conduction in the experimental arrangements which he made. Dalton and others pointed out his mistake

It will be remembered that Rumford discoursed widely on the consequences of the laws of heat displayed in natural phenomena. He discussed also the proper application of the laws to human activities, and it is not surprising to find him pointing out that if heat is to be prevented from passing between two vessels, one of them inside the other, it is well to silver the outside of the inner vessel and the inside of the outer ("Complete Works of Count Rumford", 2, 243). The same idea must have been put forward frequently when the main laws of heat were understood. For example, in a book written by Gompertz in 1850 (see letter by G. H. Gabb, *Daily Telegraph*, Oct. 12, 1935), a 'fireproof box' is described which is to consist of one metal box supported on springs within a second. The space between is to be evacuated of air to prevent conduction and convection, and the metals are to be well polished to prevent radiation. Probably the author of this idea never tried to carry it out, or he would have discovered the difficulties of construction.

Dewar was obliged to face those difficulties when during 1892–94 he was in urgent need of effective containers of liquid air. With characteristic drive and energy, he succeeded in obtaining all the vessels he wanted of many forms and sizes. One of the chief technical difficulties was naturally the join of the two vessels, inner and outer: it was difficult to get a join that could stand—as Dewar put it—"the torture to which the glass is put". A rubber cap was often provided if—in the case of the early vessels—it was necessary to pour the liquid air over the junction. The first vessels were made in London by Muller and by Gillingham: they were afterwards obtained in large quantities from Germany. Mr. George Gabb has told me that he helped Muller with some of the first silvering, and Mr. Gillingham has shown me some of the appreciative letters which Dewar wrote to him.

A very great improvement in the production and subsequent maintenance of the vacuum was made when Dewar made use of the absorbing power of charcoal Dewar points out that Davy employed caustic potash to remove traces of carbonic acid left after his air pump had done its best · and further, that de Saussure in 1815 made an extensive examination of the absorbing powers of charcoal from different sources. Tait and Dewar used this effect in 1874; they found coconut charcoal to be the best. When large containers were required, especially during the War of 1914–18, it was necessary to make them of metal, as the mechanical strength of glass was insufficient. Without charcoal the vacuum in these vessels could not have been maintained.

Dewar made splendid use of his ingenious device. His experiments had a special directness, and some were of great beauty. It is so long since they were shown in the theatre of the Royal Institution that many may like to see them, either because they have not seen them before or because they remember when Dewar performed them. As the Institution still has the services of Mr. Green, who helped Sir James in much of his later work, it is possible to repeat them in good style, and I hope that this may be done shortly.

SOME BIOLOGICAL ASPECTS OF SOIL FERTILITY

By Prof. W. Neilson Jones

THE difficulties associated with their study have probably led to an under-estimation of the importance of the biological aspects of soil fertility compared with that of the purely physical and chemical factors. An outstanding difficulty is the impossibility of reproducing in pure cultures of soil organisms the conditions present naturally in the soil, and the danger of drawing deductions from such cultures as to what the behaviour of any organism will be in the soil, where it exists as a member of the mixed soil population in a continually shifting environment Moreover, greatly as laboratory studies have advanced our knowledge of the processes of plant nutrition, they have usually failed to take full account of the complexities of the natural root environment engendered by the activities of various micro-organisms in the soil.

In the course of recent studies on the fertility of a particular soil*, methods of 'biological analysis' have been employed which are felt to be of considerable general interest in that they offer a new and promising means of experimental approach to certain aspects of soil fertility. These methods, which consist essentially in determination of the comparative reactions of the soil as a whole towards substances of known chemical composition or towards specific organisms, are yielding information as to the biological potentialities of different soils and as to the reactions taking place in them such as could not be obtained, it is believed, from study of soil organisms in pure culture alone.

The studies in question had their origin in an attempt to find a physiological basis for the behaviour of coniferous trees in certain areas of Wareham Forest, Dorset. But although these investigations have centred around the soil of this area, it should be clearly understood that this soil is not regarded as in any sense unique. It happens to be a rather extreme example of its type, and therefore specially favourable for study; but the same kind of reactions that are going on in Wareham soil intensively presumably occur in lesser degree in many soils. The phenomena associated with these soils are not of local interest only, but must be taken account of in any general study of soil biology or soil fertility.

A series of papers has already appeared bearing on Wareham Forest and describing the results of numerous experiments relating to this area[1]. It has been established that failure to make growth on the part of the trees, so strikingly apparent locally, cannot be attributed merely to poverty of nutrient salts, soil acidity, or other simple cause; and that the exceptionally good growth following upon application of certain organic composts cannot be ascribed to the available nutrients present in the compost dressing The hypothesis was put forward that the local infertility on the area is due to toxic residues formed during decomposition of organic detritus by micro-organisms; and that the effect of the compost is to provide a substrate which, by altering the serial activities of the different soil micro-organisms, modifies the chain of reactions constituting humus decomposition: with the result that the final residues, instead of being toxic, are favourable to the growth of the trees, to the mycelial growth of the fungi associated with them as mycorrhiza-formers, and to the establishment and free-functioning of a normal and balanced mycorrhizal relationship.

It is proposed here to do no more than indicate the nature of the biological test methods employed which have served to establish the existence of soil toxins of biological origin. Experimental details must be sought in the papers to be published shortly

Several independent lines of investigation have been followed.

(1) Observations of H G Morton have shown that a nutrient agar medium, buffered to pH 4·8, which develops a profuse growth of mycelium after infection from the air for a few moments, remains sterile indefinitely if spread as a thin film over Wareham soil. The conclusion is that something diffuses from the soil which inhibits fungal growth on the surface of the agar. (A standardized technique has been worked out by I. Levisohn in which chance infection from the air is replaced by inoculation from a pure culture.)

(2) Previous treatment of Wareham soil by heating, or with alcohol, etc., completely removes its inhibitory properties. This conforms to the view that the toxic substance is a product of some micro-biological activity in the soil.

(3) The toxic properties also disappear if the soil is allowed to dry out or is mixed with one of the composts alluded to above. Presumably these treatments provide conditions unfavourable to the toxic organism and/or favourable to other competing soil organisms.

* Financed by the Agricultural Research Council.

(4) Toxic Wareham soil, partially sterilized to remove its toxicity, regains its toxicity in about ten days after inoculation with untreated soil. This is confirmation that toxicity is associated with the activity of some organism.

(5) Small weighed samples of cellulose may be recovered unchanged after being buried four months in Wareham soil, similar samples undergo considerable or complete decomposition in fertile woodland soil, or in Wareham soil to which compost has been added, as a consequence of fungal attack. The inhibitory action of Wareham soil thus extends to the fungi responsible for cellulose decomposition There appears to be a direct correlation between rate of cellulose decomposition in a soil and its fertility as measured by tree growth.

To summarize: it has been shown by these methods that Wareham soil and soils like it contain a 'toxin' which inhibits growth of fungi such as air-borne moulds and mildews; some, at least, of the mycorrhiza-formers; and those responsible for cellulose decomposition in the soil. It has also been shown that this toxin results from the metabolic activity of some organism, such activity representing a course of humus decomposition largely absent in fertile soils.

[1] Rayner, M. C., *Forestry*, 1934-39

SURFACE TEMPERATURES OF THE STARS

THE abandonment of the 1939 British Association meeting at Dundee involved, among other things, the cancellation of what promised to be a discussion of great interest on the temperatures of stellar surfaces. Fortunately, however, Prof. W. M. H. Greaves's opening address on the subject appears in the October number of the *Observatory* magazine (62, 252; 1939). In his review of the present position, Prof. Greaves directs attention to the way in which recent observations—notably the colour temperature measurements carried out during the last ten years in England, Germany and France—have forced astrophysicists to the conclusion that no unique meaning can now be attached to the phrase 'the temperature of a star', because a stellar surface does not radiate even approximately as a black body.

The fundamental assumption of the early theory was that the total absorption coefficient of stellar material is not a function of the frequency of the radiation absorbed. The first deduction from this hypothesis is that the effective temperature of the radiation at any point in the star is equal to the temperature of the stellar matter at that point. From this in turn it follows that the star as a whole should behave very much as a black body, so far as its surface radiation is concerned; and on this conclusion is based the Fowler-Milne scale of ionization temperatures. But, unfortunately, the work on stellar colour temperatures developed at Greenwich, at Göttingen, and at Jungfraujoch leads to a totally different scale of temperatures. This disagreement between conclusions based on one hand upon direct experiment, and on the other upon an *ad hoc* hypothesis (for which little justification but mathematical convenience existed in the first place), has naturally proved fatal for the hypothesis.

The collapse of the assumption was not, however, entirely unexpected. The mere existence of discontinuities in stellar continua at the heads of absorption line series (notably at the Balmer limit) suggests that there is something seriously wrong with it. But in addition to this, the apparent breakdown of the Fowler-Milne scale of stellar temperatures has recently given an impetus to the mathematical investigation of various atoms with a view of determining if their absorption coefficients vary *between* the series limits. The work shows beyond doubt that such variation does exist, and it even predicts the type of variation for such simple atoms as those of hydrogen and the alkali metals. On the assumption that the absorption coefficient of hydrogen varies with the cube of the wave-length, Pannekoek (*Astrophys. J.*, 84, 481; 1936) finds that in an *A*0 star, where hydrogen is the main contributor to the spectrum, the colour temperature measured in the visual region should indeed be of the order of that observed, namely, nearly twice the effective temperature, simply as a result of this variation. At the lower temperatures of later-type stars, the more complex metallic atoms play a large part in the absorption; and beyond the qualitative result that the variation of metallic absorption coefficients with wave-length is in the opposite sense to the variation in hydrogen, little progress can yet be recorded in this direction.

Prof. Greaves concludes that future advances will call for contributions from the mathematician, in developing his treatment of the difficult general problem which allows for variability in the total absorption coefficient; from the physicist, in making laboratory measurements of the various atomic absorption coefficients; and from the astronomer, in devising and carrying out checks on theory as it develops.

A new method of obtaining the surface temperatures of stars directly from observation is announced by MM. Barbier and Chalonge in a paper following Prof. Greaves's address (*loc. cit*, p. 273). These authors, recognizing the paucity of experimental information on atomic absorption coefficients, avoid their use altogether by dealing only with those early-type stars for which the total absorption coefficient is sufficiently great for the surface to radiate effectively as a black body. The criterion they use for selecting such stars is the size of the Balmer discontinuity: where this is large, the opacity below the Balmer limit will evidently be great. In this case there is a good chance that the radiation seen will originate mainly in the outer surface layers, the temperature of which will then be what is directly observed as the colour temperature of the star.

Evidence for this view is provided by observations of the eclipsing variable star Algol. The ultra-violet colour temperature of this star (which is typical, as to size of Balmer discontinuity, of the other stars considered) is found to be independent of the phase of the eclipse. Evidently the radiation from the centre of the disk is identical in composition with that from the limb (which is, of course, surface radiation). In this case, then, and by extension in the others also, the observed colour temperature is actually the effective temperature of the surface layers. The mean value for the A_0 stars selected is 12,500° K, which is in fair agreement with the ionization temperature.

This valuable method of attack thus brings still nearer the prospect of reconciling the various 'temperatures' which can be assigned to stellar surfaces.

A. H.

OBITUARIES

The Earl of Crawford and Balcarres, K.T., F.R.S.

We record with deep regret the death of the Earl of Crawford and Balcarres, which took place at Haigh Hall, Wigan, on March 8, at the age of sixty-eight years.

The Right Hon. Sir David Alexander Edward Lindsay was born on October 10, 1871, and succeeded his father in 1913 as twenty-seventh Earl of Crawford and as holder of other titles in the peerages of Scotland and the United Kingdom. He was educated at Eton and Magdalen College, Oxford, where he graduated in 1894 with first class honours in history. He afterwards entered upon a political career, and sat in the House of Commons, holding office on occasion, until he inherited the family titles. During the War of 1914–18 he served in France as a private and as a second lieutenant until in 1916 he was recalled to England to take up office as president of the Board of Agriculture and Fisheries. Later he held other offices in the Government, among them that of First Commissioner of Works, 1921–22.

Lord Crawford's interest in, and knowledge of, art and archæology were both widespread and profound; and in the performance of his duties as First Commissioner of Works, he was brought into close touch with conditions affecting archæological studies in Great Britain. Of this he made full and effective use both as president of the Society of Antiquaries and as a prominent figure in the various organizations which have had as their object the preservation of the antiquities, monuments and amenities of town and countryside in Great Britain. His charm and his personality, as well as his public experience and knowledge, made him an invaluable and most effective leader in any and every cause in which the interests of archæology were concerned, and it was owing very largely to his influence and persuasive powers that public and official interest in British antiquities was stimulated in post-War years to greater activity in archæological exploration and also in preserving such relics of the past as remain from an over-zealous desire for improvement or the inroads of commercialism.

Lord Crawford had already acquired a considerable reputation as a scholar in artistic and antiquarian studies, notably in the field of Italian art, before his official connexion with the Office of Works. He published his well-known "Evolution of Italian Sculpture" in 1910. He was a trustee of the National Gallery and the National Portrait Gallery, and in 1923 became a trustee of the British Museum. He was chairman of the Fine Art Commission and a member of the Royal Commissions on Historical Manuscripts and Ancient Monuments, as well as of the council of the British School of Archæology at Rome. His academic achievement and services to archæological studies were recognized by honorary degrees of the Universities of St. Andrews, Cambridge, Edinburgh and Manchester. Of the last-named University he was the chancellor, succeeding the late Lord Morley in 1923. As chancellor, he took a very keen and active interest in the affairs of the University. In the following year came his election as a fellow of the Royal Society.

Lord Crawford's death will be mourned on personal grounds by all who knew him; it is no less a serious loss to the cause of humane studies, and comes at a moment when so outstanding a personality can ill be spared.

Prof. F. P. Purvis

THE announcement of the death at Seaford, on February 20, of Prof. Frank Prior Purvis will be read with regret by all those interested in the progress of naval architecture, for he was the last surviving assistant of William Froude at the Admiralty Experimental Tank at Torquay.

Prof. Purvis was nearly ninety years of age, having been born on April 18, 1850. The son of Dr. Prior Purvis, he was educated at Blackheath School, and during 1867–70 was trained as a shipwright under the Admiralty at Deptford and Chatham Dockyards, and in the old Royal School of Naval Architecture and Marine Engineering at South Kensington. While passing through his training, he gained a Whitworth scholarship, being one of the first to do so. After a short time spent at the yard of Robert Napier on the Clyde, and on the staff of Sir Edward Reed, who in 1870 had resigned the post of chief constructor at the Admiralty, Purvis joined Froude at Torquay in 1871, and remained with him for six years. From Torquay he went to Govan, serving under Sir William Pearce, but in 1879 he became head of the scientific staff of Messrs. William Denny and Brothers, Dumbarton.

Froude had no greater admirer than William Denny III (1847–87), through whose initiative the firm constructed an experimental tank similar to, but slightly longer than, the Torquay Tank. This was the first tank to be erected by a shipbuilder, and the façade of it bears an inscription saying that it was erected in memory of Froude, "the Greatest of Experimenters and Investigators in Hydrodynamics". The first experiments were made in the tank in February 1883, and later tests proved of great value in the development of the designs for the cross-Channel vessels for which the firm is well known.

Leaving Dumbarton in 1889, for the next ten years Purvis was a partner in the firm of Blackwood and Gordon, Port Glasgow, and two years after severing his connexion with them he entered upon his long career of teaching in Japan.

The interesting story of the rise of engineering education in Japan dates back to the 'seventies of last century, when Dyer, Marshall, Alexander, Divers, Perry, Ewing, Ayrton, Milne and others went out from Great Britain to teach in the old College of Engineering (Kobu Daigakko), now a part of the Tokyo Imperial University, and when British naval engineers were lent to the Japanese Admiralty. Instruction in naval architecture was originally started in the College by the late Prof. S. Miyoshi, who had learnt shipbuilding under Robert Napier, but in 1899 the authorities invited Prof. P. A. Hillhouse to occupy the chair of naval architecture in the University, and it was his post to which Purvis succeeded in 1901.

Purvis held the chair for nineteen years, during which time, from a place of insignificance, Japan rose to be one of the chief shipbuilding countries in the world. From an output of about 3,000 tons in 1900, the tonnage launched rose year by year until in 1919 the output exceeded 600,000 tons. Early in the century, too, the Japanese Government built an experimental tank, 494 ft. long, at Nagasaki.

For his long services in Japan Purvis was decorated with the orders of the Rising Sun and Sacred Treasure. He was a member of the Institution of Civil Engineers, the Institution of Naval Architects and the Institution of Engineers and Shipbuilders of Scotland, to which he contributed a few papers.

The Rev. Hilderic Friend

THE REV. HILDERIC FRIEND died in his eighty-eighth year at his home in Solihull, Birmingham, after a long illness. He was born at High Wigsell in Kent in 1852, but spent his early years in the vicinity of Hastings and always regarded himself as a Sussex man. In 1874 he entered the Wesleyan College at Richmond to train for the ministry, and two years later he sailed as a missionary to China. Ill-health compelled him to return home in 1880 and, with a view to his recuperation, he was given a series of country circuits for his pastoral care. His first was at Newton Abbott in Devonshire, where he spent much time in the open air and began to study field botany systematically. Here he wrote "A Glossary of Devonshire Plant Names". This was succeeded in 1884 by "Flowers and Flower Lore" and by "The Ministry of Flowers" in 1885.

After travelling all over the country in his ministerial capacity, Mr. Friend retired in 1914. For many years he had interested himself in worms, and he now devoted his leisure to their more thorough study.

As the result of his labours science was enriched with the knowledge of many new species, and contributions from his pen have frequently appeared in the columns of NATURE. He was a voluminous writer, and was the author of more than a dozen books and of several thousand articles. In 1937 he successfully recovered from a serious operation, but a few weeks later his wife passed away. He never recovered from the blow. He died on February 7, leaving a son, Dr. J. A. Newton Friend, who is head of the Chemistry Department, Technical College, Birmingham, and a daughter.

WE regret to announce the following deaths:

Prof. W. C. Brøgger, rector of the University of Oslo and a foreign fellow of the Geological Society of London, on February 17, aged eighty-eight years.

Dr. R. T. Gunther, curator of the Oxford Museum for the History of Science, University reader in the history of science, on March 9, aged seventy years.

Prof. E. Maragliano, emeritus professor of clinical medicine in the University of Genoa, a pioneer in tuberculosis research, aged ninety-one years.

Prof. Károly Schaffer, emeritus professor of neurology and psychiatry in the University of Budapest, aged seventy-five years.

NEWS AND VIEWS

Phillippe de La Hire (1640–1718)

ON March 18 the tercentenary occurs of the birth of Phillippe de La Hire, one of the most versatile of French men of science of the later half of the seventeenth century. The son of Laurent de La Hire, a famous painter, who died in 1656, he was instructed in art, but he also learnt mathematics from Gaspard Desargues, the friend of Pascal and Descartes. When twenty years of age, he went to Italy, where he spent four years On returning to Paris, he resumed his mathematical studies and, during the next forty years, published many papers and books on geometry, conic sections, epicycloids, magic squares, and other subjects. His work on magic squares was based on the treatise of the fifteenth century Italian mathematician Emmanuel Moschopulus.

La Hire also, from 1683 onwards, made astronomical observations at the Paris Observatory, where the elder Cassini and Picard were similarly engaged, and with them, too, he carried out geodetical work for the map of France planned by Colbert. His physical work included researches on the variation of the compass, on refraction and barometric and thermometric measurements. He was elected a member of the Royal Academy of Sciences in 1678, and for a number of years held a chair in the Collège Royale de France. "Astronomer, mechanician, geometer, hydrographer," said Fontenelle, "he was an academy of sciences in one man". He was twice married and had eight children, of whom two, Gabriel-Phillippe (1677–1719) and Jean-Nicolas (1685–1727), were also members of the Academy of Sciences. La Hire died in Paris on April 21, 1718.

Jules Christian (1840-1907)

DR. JULES CHRISTIAN, an eminent French alienist, was born at Bischwiller in Alsace on March 16, 1840. He studied medicine at Strassburg, and for three years before graduating became a resident in the Stephansfeld Asylum (Bas-Rhin), which provided him with a rich field of psychiatric study. In 1863 he obtained the Esquirol Prize offered by the Société Médico-psychologique with an essay on the dura mater in the insane, and in the following year qualified with a thesis on hæmorrhagic pachymeningitis. During the Franco-Prussian War he took an active part in looking after the wounded, and after the peace of Frankfort in 1871 left his practice in Alsace and joined the staff of the Montevergnes Asylum in the Vaucluse Department, where he remained for nearly four years and made numerous contributions to the *Annales médico-psychologiques* and *Archives générales de médecine*, of which the most important were those on injuries in the insane, insanity following acute disease, and sensory changes in melancholia.

In 1876 Christian was appointed physician to the Maréville Asylum near Nancy, where he made a special study of general paralysis and epilepsy, and won the Falret Prize awarded by the Académie de Médecine by a work on epilepsy in relation to insanity. He also delivered a course of lectures at the time on mental disease, at the Nancy medical faculty, and would probably have been appointed professor in this subject, but in 1879 he was made physician to the asylum of Charenton, where he remained until his retirement in 1904. During this long period he made many more valuable contributions to the literature of mental disease, of which the chief were those on epilepsy and epileptic insanity, for which he gained a prize awarded by the Belgian Royal Academy of Medicine, and on dementia præcox. He died on July 11, 1907.

Countering the Magnetic Mine

ACCORDING to the naval correspondent of *The Times*, a conspicuous feature of the *Queen Elizabeth* on her arrival at New York after her secret maiden voyage from the Clyde was a 'girdle' around her hull. This girdle is apparently the means of protection adopted against the magnetic mine The girdle, supplied with electric current of the necessary strength and characteristics, sets up a magnetic field which, in association with the steel hull and other magnetic material of the ship, is such that magnetic mines laid at sea are not set off by the passage over them of a vessel so equipped. The apparatus is said to have been devised and developed by officers of one of H.M. naval establishments, with the advice and assistance of scientific men consulted for the purpose. It has been given the expressive name 'de-gaussing girdle', the aptness of which will be recognized by all with an elementary knowledge of magnetism.

Mr. Winston Churchill paid a tribute to this piece of work in his review of the war at sea when introducing the Navy Estimates in the House of Commons on February 27. He said, "We see our way to mastering the magnetic mine and other variants of the same idea. How this has been done is a detective story written in a language of its own . . . we do not feel at all outdone in science in this country by the Nazis." This is all the thanks which can be given at present for the work of some few of the men of science who have given up their investigations to put their special knowledge and skill at the service of the country. It is an achievement of high order to have devised protection against a relatively novel form of attack in so short a time, and should encourage the further use by the Government of scientific talent.

Blood Groups and Racial Diagnosis

IN view of the stress laid by many anthropologists on the significance of the blood groups in the racial classification of man, attention may be directed to the results of certain investigations of the weak *A* reaction found in some cases of the group *AB* by G. L. Taylor,

R. R. Race, Aileen M. Prior and Elizabeth W. Ikin (*Brit. Med. J.*, Feb. 24, 1940). It had already been shown that in some AB cases the factor B is partially dominant to and obscures the A antigen; and that while there tends to be some weakening of the B reaction in group AB, it is nothing like so marked or so important as is the suppression of A. As there are two types of A antigen, A_1 and A_2, a stronger and a weaker, the suppression by B of an already weak A_2 in the group A_2B may result in it only being possible to detect the A factor with powerful anti-A serum, the cells otherwise being diagnosed as group B.

Following on the observations recorded, it is shown that the order of decreasing strength of reaction is A, A_1B, A_2, A_2B. Further, as the serum from quite a number of A_2B cases contains the antibody α_1, which reacts with A_1 but not with A_2 cells, unless appropriate measures are taken, a reaction will result which confirms the diagnosis of group B. In view of the significance attached in anthropological classification to the distribution both within a given population and geographically of the elements A and B, it is of interest and importance to note that cases diagnosed as B have been found on re-examination to belong to group AB, and an inspection of published figures from all parts of the world shows that in a large proportion of the series there is a real deficiency of the numbers in group AB. It is possible that herein lies a clue to the explanation of certain anomalies and apparent irregularities to be noted in studies of the groups as racial elements.

The Black Rat in Great Britain

NOT so long ago it was generally said that the black rat, *Rattus rattus*, had disappeared from Britain, ousted in unequal contest with the brown new-comer, *Rattus norvegicus*. But to most naturalists interested in the subject it was known that little centres existed in wide-scattered areas where a black rat could be found if it was wanted. Now Colin Matheson, in an interesting account of results derived from his own observations in Cardiff and from a *questionnaire* sent to medical officers of health in "approved ports", discloses a somewhat disturbing situation about the black rat, the carrier of the flea, which in its turn disseminates plague (*J. Anim. Ecol.*, 8, 76; 1939). Stringent regulations are in force to ensure that ships are kept free of rats, and that while ships are in port it should be made extremely difficult for inboard rats to make a passage to the shore. The result has been a general decline in the rat population of ships visiting Britain, although a number averaging 6–8 seems to be the irreducible minimum on rat-infested ships.

On shore, however, in spite of rat-weeks and rat-prevention measures, the number of black rats appears to be on the increase, the statistics for thirteen British seaports showing a rise from about 4,110 in 1929 to more than 6,437 in 1934 and 5,362 in 1937. Moreover, the shore companies appear to be extending their range from the neighbourhood of docks to city areas, in some of which they are well established, and are able to maintain themselves without further accessions from the dockyard immigrants. Of the three commonest races of the black rat the most frequent in British seaports is the typical black form, *R. r. rattus*, but curiously enough the brownish *R. r. alexandrinus* takes the lead in numbers in London and Plymouth.

Activities of Analytical Chemists

IN his presidential address to the Society of Public Analysts and other Analytical Chemists delivered on March 6, Prof. W. H. Roberts pointed out that there has been much less need in this War than in the last for the formation of *ad hoc* committees of chemists to deal with problems with which the Government departments found themselves faced, for much had been foreseen and provided for; and some of the departments had from the outset adopted the course of appointing to their staffs eminent outside chemists, who not only brought to the departments their own expert knowledge but also rendered the departments more accessible to suggestions and representations from outside chemical bodies. The compilation of the National Service Register by the Ministry of Labour, in which the Society had co-operated, had provided the Government with a source of specialized personnel. The conditions of appointment of gas identification officers needs reconsideration, especially in view of the duties now placed upon them in respect of preliminary food tests for gas-contamination. Referring to the Food and Drugs Act of 1938, Prof. Roberts said that the rationing of meat would probably lead to increased consumption of certain other foods, such as sausages and cheese, and regulations governing the content of meat in sausages and of water in cheese (particularly processed cheese) would therefore become very necessary.

The number of analysts and consultants in independent practice has diminished greatly in recent years, Prof. Roberts said, but in the public interest it is important that there should be a strong band of such chemists, not attached to any special interest, and it was therefore necessary to watch closely for cases of unfair competition by publicly supported laboratories. Speaking of the necessity of maintaining a high standard of efficiency amongst analysts, he expressed regret that no English university has yet inaugurated a chair of analytical chemistry, and also suggested that the universities should exercise more rigorous selection to ensure that only students having a real aptitude for the subject should be admitted to their courses. The roll of the Society now includes 886 names. The following officers for the year 1940–41 were elected: *President*, Dr. E. B. Hughes; *Hon. Treasurer*, G. Taylor; *Hon. Secretary*, Lewis Eynon.

The Ray Society

AT the annual general meeting of the Ray Society held on March 6, under the presidency of Sir Sidney Harmer, Lieut.-Colonel R. B. Seymour Sewell was elected a vice-president and Sir David Prain, Dr. [illegible] W. T. [illegible] deceased) and Mr. C. S. Todd new members of

council. It was announced that the first volume of Prof. F. Balfour-Browne's "British Water Beetles" would shortly be issued to subscribers for 1939. The council, in its annual report, referred to the difficulties with which the Society is faced as a result of the War. The report continues: "The Council believe, however, that the work of the Society ought to be carried on as far as it is possible to do so in war time In common with other scientific bodies, the Society has a definite function to perform in helping to maintain the continuity of our national life, of which its activities are a very small, but, as the Council believe, not a wholly negligible part. It is proposed therefore to go on with the publication of the works now being prepared, and the Council appeals to all members who are able to do so to continue their support of the Society."

Association of Scientific Workers: New Branch

THE recently formed Glasgow branch of the Association of Scientific Workers held its inaugural meeting in the Royal Technical College, Glasgow, on March 6. The proceedings opened with a display of films portraying the history of the vitamins and developments in the use of the cathode ray oscillograph. Dr. J. D. Sutherland, chairman of the branch, referred briefly to the aims and work of the Association and then called upon Prof. W. F. K. Wynne-Jones to deliver the inaugural address. Prof Wynne-Jones led up to the general question of the organization of science and scientific workers by considering the planning of research. He said he is strongly opposed to the view that research should not be organized, and expressed the opinion that valuable results will only be obtained from an investigation if it is carefully planned beforehand. He contended that scientific research arises fundamentally from the needs of society, and illustrated his point with several very pertinent examples from the history of science. In furtherance of his argument for increased organization among scientific workers, Prof. Wynne-Jones spoke of the poor financial support received by research in Great Britain and of the muddles that had arisen at the outset of the War because men of science had not been called upon to organize services which belonged essentially to their province. Science can and must be organized, and to this end scientific workers must develop a corporate sense.

Rhodes Scholarships for India

THE Rhodes Trustees have decided to found two Rhodes Scholarships annually for India. The Rhodes Scholarships are of the annual value of £400, and tenable at the University of Oxford. With one or two exceptions they are awarded to young men who have been educated at universities in the British Dominions or in the United States of America. Cecil Rhodes laid down in his will that in the election of a scholar special regard should be paid to his scholastic attainments, his fondness for manly outdoor sports, his qualities of manhood, truth, courage, devotion to duty, unselfishness and sympathy for the weak, and his powers of leadership. The Rhodes Trustees are confident that candidates fully up to the high standard set by previous Rhodes Scholars will be forthcoming from India, and they have been assured that Indian Rhodes Scholars will be welcome at Oxford. These scholarships are founded for an initial period of five years, after which they will be reviewed in the light of experience. The first Indian Rhodes Scholars will go into residence at Oxford after the end of the War. This is the second announcement of post-graduate awards for Indian students which have been made in recent years; it will be recalled that the Commissioners of the Exhibition of 1851 instituted exhibitions for India in 1937.

The Conception of the Atomic Clock

THE presidential address to the Section of Physics of the American Association for the Advancement of Science, which was delivered at Columbus on December 29 by Dr. Herbert E. Ives, is printed in *Science* (91, 79; 1940). The address is entitled "The Measurement of Velocity with Atomic Clocks". Taking the variation of atomic clock rate as an experimental fact, established by the Doppler effect in hydrogen canal rays, and adopting also the Fitzgerald contraction of moving rods indicated by the Michelson-Morley experiment, Dr. Ives points out that it is possible to define 'velocity' in various ways, none of which has any *a priori* claim to be chosen as 'correct'. The Restricted Theory of Relativity corresponds to the choice of one of them "They are all deviations from the simple Newtonian concept of velocity", says Dr. Ives, "which is in terms of rods and clocks which are unaffected by motion. I urge the merit of the Newtonian framework as the only unambiguous basis for the idea of velocity". Dr. Ives does not consider that the ether has been "abolished" simply because it is possible to define velocity in a manner which makes it unnecessary to refer to that medium: he claims that the Sagnac experiment, in which beams of light moving in opposite directions round a rotating disk produce movable interference fringes, gives experimental evidence of the existence of the ether. His views, he says, "will be recognised as those of the earlier students of the subject—Fitzgerald, Larmor, Lorentz—but not of those who would shift the burden from variant measuring instruments to the nature of space and time".

Relativists will probably not be convinced by Dr. Ives's arguments. They will ask why, if there are invariant measuring rods and clocks, we cannot discover them but have to use those which vary with motion; and further, why, of varying ones, we cannot tell in what state they approximate most closely to those which are immutable. It is to be noted also that Dr. Ives's address scarcely justifies the choice of title. An atom may be *conceived* as a clock, but cannot possibly be used as an instrument for measuring time or velocity unless we make an *ad hoc* definition of velocity in terms of wave-length changes and define an atom as a light-wave.

Treasure of Psusennes

Now that the sarcophagus of Pharaoh Psusennes found on the site of the ancient Tanis (NATURE, February 24, p. 300; March 9, p. 382) has been emptied of its mummy and associated jewellery, it has been possible to form a more just estimate of the magnitude of the find. It is regarded as one of the richest discoveries ever made after that of the tomb of Tutankhamen (*The Times*, March 7). In this collection of remarkably beautiful jewellery, some of the necklaces, as described, are outstanding. One, for example, is composed of two heavy bars of gold supporting a centre-piece in the form of a golden lotus, which is so heavy, it is said, as to emit a gong-like note when the necklace is shaken. Another necklace consists of several huge pieces of lapis lazuli with gold clasps, on which there is an inscription saying that the King had had made for him a necklace which never would be equalled. This necklace scales the remarkable weight of 12 lb. Among other objects of jewellery in the find are mentioned further necklaces, two bracelets, golden slippers with a golden case, pins and studs. All the antiquities found, with the exception of the granite sarcophagus, are being transferred to the Cairo Museum, where they will be placed on exhibition forthwith.

Meteorology in British East Africa

THE director of the British East African Meteorological Service, Mr. A. Walter, describes the work achieved by his Service in 1938 in his annual report for that year. Although described by him as an extremely difficult year, no hint of this would be obtained from a consideration only of the work achieved and the preparations made for extending and improving the activities of future years. Many of the staff fell sick because it had been impracticable for them to take the vacation leave to which they were entitled, and the training of all grades of staff had to be maintained; it was estimated that this would have to be continued for another five years before each section of the Service could become a fully efficient and self-contained unit.

There is much of interest both on the climatological and synoptic sides in this report, and evidence that important contributions to the understanding of meteorological processes are being made. During the course of the year the whole region, which includes Kenya, Tanganyika, Uganda and Zanzibar, has been divided up into zones characterized by peculiarities in the seasonal distribution of rainfall. Seven such zones were found sufficient to cover broadly the observed range of variation, and have been made the basis of a division of the country into forecast areas, which are shown on a map (p. 27). Both daily and weekly forecasts have been appreciated by the resident population and by visitors, an evidence of this interest being the suggestions received for increasing their frequency and extending their range. The weekly forecasts are based mainly on the relative positions of the high- and low-pressure systems on either side of the tropics and the probable changes in the main wind currents connected with them. They are described as an unqualified success, a fact which is modestly explained as being due to the circumstance that the effects of high or low pressure appearing off the west coast of Africa are generally felt about a week later in the tropical regions of East Africa.

Many planters have stated that their work is planned in accordance with the indications of the weekly forecasts. Local eccentricities of response to general changes are, however, an obstacle to accurate forecasting here as elsewhere, and it is stated (p. 25) that small short-period variations of pressure, temperature and upper winds are showing a significance which would be considered out of all proportion to their magnitude and duration in the meteorology of temperate regions. This report deserves to be regarded as a model for a young progressive meteorological service in the tropics.

Suggested Grid in the United States

CONFERENCES have recently been taking place in Washington with the officials of some fifty large public utility companies operating in the eastern part of the United States to explore the possibilities of constructing a series of high-voltage lines interconnecting the larger generating plants and power-consuming centres in this area, including both private and public developments. According to the *Electrical Review* of February 9, although up to the present no definite plan has actually been made public, the proposals include connecting links that would make it possible to interchange power whenever necessary between such major load centres as Boston, New York, Philadelphia, Washington, Buffalo, Cleveland, Detroit, Chicago, St. Louis, and possibly Birmingham. Connexions would be made with all major generating stations, both steam and hydro-electric, without regard to whether they are controlled by private capital, municipalities, or the Federal Government.

According to preliminary estimates, the construction would cost approximately £100,000,000. Objections to the plan have been raised owing to the ample generating capacity now in existence or under construction in each of the localities to meet possible future demands. It is also contended that the expenditure of such a large amount would impose an unnecessary financial burden upon consumers of electricity. The advocates of the scheme take the view that the future growth of power demand will be at an accelerating rate and that the rate of construction can be adjusted to actual needs for the new facilities. They are also understood to be relying strongly on the national defence argument, on the assumption that, even though temporarily uneconomic, the Grid can be justified as a safeguard against the power shortages experienced by American industry during the War of 1914–18.

New Radio Transmitter

ALMOST unnoticed in the unsettled international atmosphere that existed last August, an extraordinary radio transmitter was inaugurated in the pocket republic of Andorra, which bestrides a small section

of the Pyrenees on the frontier between France and Spain. A brief account of this station is given in the *Electrician* of March 8. The President of the French Republic (as successor to the Kings of France) and the Bishop of Urgel in Spain share as co-princes the over-lordship of Andorra, a condition which has lasted since the early part of the ninth century. Radio Andorra is situated on a rocky hill at an altitude of 2,920 ft. above sea-level, but its aerial is placed at an altitude 2,460 ft. higher and is suspended across a lake; the supports, 410 ft. high, are 820 ft. apart. The feeder cable between the station and the aerial is 2,788 ft. long and is believed to be the only case in which a distance of this order separates a transmitter and its antenna, with the exception of the Eiffel Tower, where ultra-short waves had to be considered. At Andorra transmitters for medium and short waves are installed. The energy required for the station is 350 kilowatts and is obtained from the Forces Hydro-électriques de l'Andorra, a water-power undertaking, which sells the bulk of its production outside the borders of this small State

Illness in Meat Packing Industry

IN a recent paper (*Public Health Rep*., **54**, 2196, 1939) Hugh P. Brinton, assistant statistician, Harry E. Seiffert, assistant public health engineer, and Elizabeth S. Frasier, junior statistician, United States Public Health Service, present an analysis of cases of sickness and non-industrial injuries lasting eight calendar days or longer among workers in the slaughter and meat-packing industry. The annual number of cases per 1,000 was 95·0 for white males, 144·2 for white females, and 137·9 for negro males, while the average number of days of disability per person was 3·16, 4·85 and 4·01 respectively. Those who showed the highest figures in the form of an excess of respiratory diseases were cold-meat workers among white males, scalers, wrappers and packers among white females, and by-product workers among negro males.

Very excessive rates for rheumatic diseases were found in certain occupations, especially those of warm- and cold-meat workers, sausage and casing workers, and curing workers. As regards environmental conditions, white males exposed to high humidity or wet had the highest rates, with non-respiratory and non-digestive diseases most in excess. Among white and negro males the highest incidence was found among those working in hides and wool, or glue and entrails, among whom digestive diseases were much commoner than the average. White males and white females showed sickness-rates in decreasing order of magnitude as follows: semi-skilled workers in manufacturing, labourers, and clinical workers.

New Seismographic Equipment in the United States

A NEW seismograph station has been established at Lincoln, Nebraska, and new equipment has been installed at Chicago, Salt Lake City, and Bozeman, Montana, all co-operating stations of the United States Coast and Geodetic Survey, according to J. H. Nelson and H. E. McComb. The new seismograph station is on the campus of the Nebraska Wesleyan University in Lincoln, Nebraska, and is situated on a layer of loess and glacial clay 150–175 ft. thick, under which is several hundred feet of Cretaceous sandstone. The position is latitude 40° 49·1′ N., longitude 96° 42·2′ W., altitude 358 ± 5 metres.

The seismograph operates as an east-west component and is a small experimental McComb-Romberg tilt-compensation seismometer having magnetic damping and a clock-driven completely enclosed recorder. Time control is furnished by a Seth Thomas pendulum clock compared daily with naval radio time signals from Arlington. Tilt compensating instruments have been installed at Chicago on account of the slow irregular tilt movements of the pier on which the seismographs rest. Salt Lake City (latitude 40° 45·9′ N., longitude 111° 50·9′ W., altitude 1433 ± 5 metres) had a two-component 100-kgm. Bosch-Omori seismograph and has recently installed a two-component small model McComb-Romberg tilt-compensation seismograph. At Bozeman, oil damping has been replaced by magnetic damping and the recording equipment has been improved.

Smoke Abatement

THE National Smoke Abatement Society has issued its quarterly, *Smokeless Air*, on a reduced scale but with a supplement "Smoke Abatement in War Time". This is an effort to rebut the belief that reduction of smoke under present conditions is unimportant. The impression that smoke serves a useful purpose by screening towns against air attack is challenged. A smoke screen may assist a moving object such as a ship, but serves as a landmark fixing the position of a stationary group such as a town. It may provide a screen to hinder the recognition of a specific object, but equally it conceals the attacker from the defence. Concealment is a great help to the submarine, and recent experience shows its assistance to raiding aircraft. The pamphlet directs attention to the way in which colliery tips serve as landmarks, providing a "difficult problem" in smoke abatement. The difficulty, it may be indicated, is less technical than political and due to the fact that the disposal of pit refuse is left to the discretion of the individual colliery. Naturally the cheapest possible method is used, regardless of the effect on the surrounding people, land and of the ultimate cost to the community. The chemical composition of pit refuse is such that self-ignition can scarcely be prevented when it is dumped in enormous heaps. Too often collieries are surrounded by low-lying land reduced to valueless swamp by mining subsidence. Pit refuse would serve a useful purpose, if used to raise the level of such land, and under such conditions firing would not occur.

Smoke results from the liberation of the volatile matter of coal, a large part of which is liquid. Smoke abatement is a movement for collecting this liquid for useful purposes instead of dispersing it as a public

nuisance.* Present conditions emphasize the wisdom of smoke abatement as a national defence measure. The national need for liquid fuel cannot, it is true, be met by the carbonization of coal, but the contribution is already by no means negligible. Already in 1938, 8 per cent of the motor spirit consumed in Great Britain was obtained from coal The quantity of heavier oil suitable as fuel was of the same order. The pamphlet makes a plea for a planned fuel policy, saying that "smoke is a by-product of the technologically primitive phase of industrial civilization from which we have not yet emerged".

The Cooper Union

THE eightieth annual report of the Cooper Union for the Advancement of Science and Art covers the year ended June 30, 1939 (Pp 122. New York, 1939). The report of the Director, emphasizing the extent to which industry is becoming more scientific, refers to the increase in basic instruction in science and mathematics in the engineering schools, and decreased instruction in detailed applications of engineering. Special stress is laid in this report on the integrated study of the social sciences, so as to develop the mind of the engineering student not only to think rationally and scientifically, but also to be able to grasp concepts that do not admit of the precise analysis, calculation and control with which the physical scientist and engineer have been accustomed to work and which have hitherto been the accepted limit of his knowledge and proficiency

The Director considers that humanistic studies should be required throughout the four or five years of undergraduate training. Commenting on our failure to stir those interests which lead the engineering graduate to continuing his studies of science and society, he urges that the impasse which faces civilization to-day is due to our attacking our problem by rule of thumb, expediency and self-interest, instead of by the scientific method, which, if coupled with sensitivity to the human values of freedom and individuality, will save civilization from the irresponsible technologist and the scheming politician.

Control of Spirit

FOLLOWING the introduction of prohibition in Bombay, the Government has restricted sales, advertising and general dealing in all spirituous preparations containing more than 2 per cent by volume of alcohol. Recently, however, the Bombay Government has entirely exempted all toilet and cosmetic preparations containing alcohol from the prohibition regulations. It has also set up a Classification Committee to decide whether preparations which contain more than 2 per cent of alcohol can be used as beverages or not.

Non-Ferrous Metallic Ores

THE Minister of Supply has appointed a departmental committee to consider whether an increased production of non-ferrous metallic ores in the United Kingdom is desirable and practicable, and to make recommendations. The members of the committee are: Sir William Larke (chairman), Dr. C. G. Cullis, Mr. Arthur Deakin, Mr. J. Stanley Holmes, M.P., and Mr. S. S. Taylor. Prof. J. A. S. Ritson, Mr. T. Eastwood, and Dr. M. Macgregor will act as assessors to the committee. The secretary of the committee, to whom all communications should be addressed, is Mr. W. C. C. Rose, Geological Survey of Great Britain, Exhibition Road, South Kensington, London, S.W.7.

Colonial Appointments

THE following appointments and promotions in the Colonial Service have recently been made: H. K. Littlewood, veterinary officer, Nigeria; R. R. Temple, veterinary officer, Tanganyika Territory; C. L. Skidmore, agricultural superintendent, senior agricultural superintendent, Gold Coast; Dr. F. Dixey, director of geological survey, Nyasaland, director, Water Development Department, Northern Rhodesia; H R. Binns, formerly veterinary officer, Nyasaland, veterinary research officer, Palestine; R. Leach, mycologist, Nyasaland, plant pathologist, Jamaica (temporary).

Announcements

THE tenth Joule Memorial Lecture will be delivered before the Manchester Literary and Philosophical Society by Prof. James Chadwick, professor of physics in the University of Liverpool, on March 19 at 5.30. His subject will be "New Applications of Physics to Medicine".

PROF. F. L. WARREN, formerly of the Fuad I University, Cairo, has been appointed professor of chemistry in the Natal University College, Pietermaritzburg.

THE fourth International Congress of Malaria will be held in Rome on the occasion of the International Exhibition of 1942

THE Australian Commonwealth Government has set up a Central Medical Co-administrative Committee at the seat of Government at Canberra. The Committee will control all drugs and medical equipment so as to ensure the best use for the armed forces and civil population during war-time.

THE milk in schools scheme has been resumed for all children of school age, especially those in London. Voluntary milk clubs are being organized by teachers at schools and at certain other premises where children attend for some form of instruction. More than 200 of these clubs have already been formed and the number is growing almost daily. As in peace time, all children are asked to pay ½d. for each half pint of milk.

IN the article entitled "Food Production and Food Control" by Sir John Orr published in NATURE of March 9, p. 374, col. 2, last line of par. 3, the phrase "10 and 20 per cent" should read "5 and 10 per cent". This correction was received during the printing-off of the journal and was made in a part of the issue only.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 429. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Molecular Structure of the Collagen Fibres

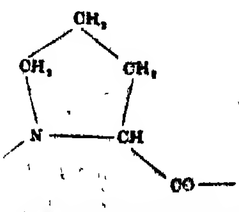
X-RAY studies of the fibrous proteins indicate that they fall almost exclusively into one or other of two main configurational groups, the keratin-myosin group and the collagen group[1]. The interpretation of the structure and properties of the former group is now well advanced and has frequently been reported on in NATURE and elsewhere, but the structure of the latter, in spite of many investigations, has hitherto remained unexplained. It was suggested several years ago that the amino-acid residues in gelatin (which also gives the typical collagen diffraction pattern) are somehow grouped in threes with probably every third a glycine residue and every ninth a hydroxyproline residue, that the strong meridian arc of spacing about 2·86 A. is associated with the average length of a residue in the direction of the fibre axis, and that such an average length could very well arise from an alternate *cis*- and *trans*-configuration[2]; but further progress was not possible for lack of experimental data. More recent chemical and X-ray evidence points now to a solution that is both simple and convincing.

(1) Bergmann[3] concludes that the average residue weight in gelatin is about 94, and that the chief residues are present in the proportions set out in the accompanying table:

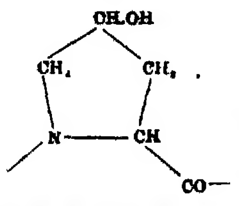
AMINO-ACID FREQUENCIES IN GELATIN

Amino-acid	Wt. %	Mol Wt.	Gm Mol.	Frequency
Glycine ..	25 5	75	0·34	3 ($2^0 \cdot 3^1$)
Proline ..	19·7	115	0 17	6 ($2^1\ 3^1$)
Hydroxyproline	14·4	131	0 11	9 ($2^0\ 3^2$)
Alanine .	8·7	89	0·098	9 ($2^0\ 3^2$)
Arginine .	9·1	174	0·052	18 ($2^1\ 3^2$)
Leucine-isoleucine ..	7 1	131	0·054	18 ($2^1 \cdot 3^2$)
Lysine ..	5 9	146	0·040	24 ($2^3 \cdot 3^1$)

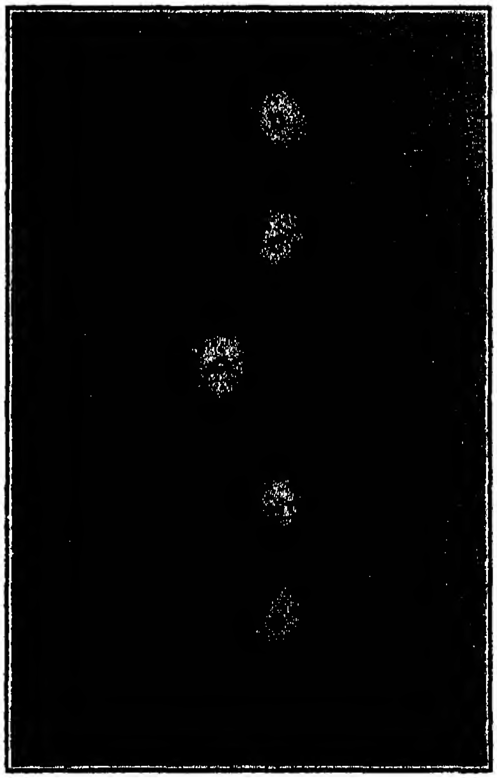
Thus not only are one third of the residues glycine residues, but also, except for one residue in eighteen, another third are either proline or hydroxyproline residues; that is to say, are of the form:



or



The table shows too that there cannot be fewer than 72 residues in the gelatin 'molecule' (there will not be any definite molecule of gelatin itself, but only large, and possibly somewhat modified, fragments of the original collagen pattern): the true number must be a fairly high multiple of this, possibly 576, to judge by the histidine content for example.



(2) The side-chain and backbone spacings in dry gelatin are about 10·4 A. and 4·4 A., respectively, while the density is about 1·32 gm./c.c. Suppose these two spacings to be inclined at an angle β, and the average length of a residue in the direction of the fibre axis to be L A., then

$$94 \times 1{\cdot}65 = \frac{10{\cdot}4 \times 4{\cdot}4 \times L \times 1{\cdot}32}{\sin\beta}$$

that is, $L = 2{\cdot}6 \sin\beta$ (approx.),

and therefore L cannot be greater than about 2·6 A. This is only an approximate calculation, but it is sufficiently accurate to confirm that the strong meridian arc of spacing 2·86 A. is almost certainly associated with the average length of a residue.

(3) If it is actually equal to it, as seems most probable, and the residues follow one another in a row, then from the table the minimum length of the intramolecular pattern along the fibre axis is about 72 × 2·86 A. This length is not only too small to include the residues of other acids, such as histidine, omitted from the table, but also it is too small to account for the meridian spacings reported by Wyckoff and Corey[4] and by Clark and co-workers[5]. Their data are best explained by a sequence of 4 × 72 residues in a row, grouped in approximate sets of 12, 24 and 36. This gives a molecular weight of about 27,000, or a multiple thereof, corresponding to Svedberg's gliadin class[6].

(4) The proposed partial *cis*-configuration[2] is readily accounted for by the preponderance of imino residues. When we allow for this and the glycine content, there seems to be only one reasonable solution, represented by the scale model shown in the accompanying illustration. The basic sequence is -*P*–*G*–*R*–, where (with the exception of one residue in eighteen) *P* stands for either proline or hydroxyproline, *G* for glycine, and *R* for one or other of the remaining residues. The full-length pattern, and also variations within the collagen group as a whole, must arise by suitably modifying this simple theme.

Using the interatomic distances found in silk fibroin, the average length per residue in the pattern shown in the illustration works out to be 2·85 A., almost exactly the spacing of the strong meridian arc. Other points in favour of the model are: (*a*) there is no steric interference between the side-chains, the longer side-chains all lying on the side of the main-chain remote from the rings, leaving only the unobtrusive glycine side-chain (*-H*) on the same side as the rings; and (*b*) the polypeptide chain proceeds in a straight line, and any attempt to stretch it results in the side-chain (*-R*) swinging over towards the rings and the system coiling back upon itself: thus we have an explanation of the paradox that though the collagen configuration is shorter than that of the β-proteins, it is nevertheless practically inextensible.

The above solution of the collagen problem permits now of the broad generalization that all the extended forms of the fibrous proteins fall into either of two classes: they are built from polypeptide chains in either the *cis*- or the *trans*-configuration.

A fuller account of this investigation may be found in the first Procter Memorial Lecture[7], and a more detailed discussion still will be published elsewhere.

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Capture Cross-Sections for Thermal Neutrons in Thorium, Lead and Uranium 238

EXPERIMENTS on the processes arising in thorium under neutron bombardment have shown that nuclear fission is induced only by fast neutrons of energies of about 2 Mev. or more. There exists also a radiative capture process producing an isotope of thorium (Th 233) of 26 min. half-life; this process has a resonance character with a large contribution from thermal neutrons[1]. So far, the capture cross-section of thermal neutrons in thorium has not been measured. The following experiments were carried out in order to determine this cross-section.

As the neutron source available was not very strong (100 mgm. Ra + Be), all dimensions had to be kept as small as possible. On the other hand, in order to obtain high accuracy of measurement, one had to use an absorbing thorium layer of reasonable thickness. By the kindness of Prof. Coster, I obtained a sample of metallic thorium of more than 99 per cent purity. Dysprosium of the highest purity, also kindly given me by Prof. Coster, was used as detector. The thorium was almost exactly prismatic in form (1·2 cm. × 1·2 cm. × 2·96 cm.). The dysprosium was a thin layer (15·7 mgm./cm.^{2} Dy) of rectangular form, 1·0 cm. × 2·7 cm., and its upper face was covered with 2 μ 'Cellophane'. For the absorption measurement the thorium was placed directly on the dysprosium with or without a cadmium screen, so that the neutrons impinging normally had to go through 1·2 cm thickness corresponding to 13·4 gm thorium.

The experimental arrangement was as follows. In a plate of paraffin wax of 3·8 cm. thickness, there was cut out a rectangular cavity of 1·3 cm. depth, the bottom and sides of which were covered with cadmium of 0·5 mm. thickness so that thermal neutrons could not enter except from above. This plate was put between two other plates of paraffin wax, forming in this way a block of 11·5 cm. height and about 25 cm. × 25 cm. area. The dysprosium was placed on the cadmium-shielded bottom of the cavity. The upper paraffin plate contained the neutron source 3·3 cm. below the surface in such a way that the source just touched the upper edges of the cadmium screened cavity.

The activity of the dysprosium detector was measured with a Geiger-Müller counter with 0·1 mm. aluminium walls connected to an amplifier. The dysprosium, the half-life of which was carefully determined and found to be 156 ± 3 min., was in all experiments irradiated up to saturation, and the decay of the activity was followed for several hours in order to increase the accuracy of measurements. All measurements were referred to a uranium standard. The contribution from thermal neutrons was determined by carrying out the irradiation with and without 0·5 mm. cadmium directly over the exposed face of the detector. With cadmium screens on all faces of the detector, the observed activity is due to neutrons faster than thermal neutrons. Under the experimental conditions used here, it amounted to 9 per cent of the activity obtained without cadmium on the exposed face.

For the determination of the capture cross-section for thermal neutrons in thorium, one has to consider the different kinds of interaction of neutrons with the thorium nucleus. The fission cross-section of fast

neutrons is so small as to be negligible. The same holds for the radiative capture cross-section of fast neutrons. Therefore for fast neutrons one has to take into account the scattering cross-section only. Because of the arrangement used—the absorber being put directly on a detector of nearly equal size—one would expect that practically all the scattered neutrons would be efficient in the irradiation, that is, the scattering cross-section would not enter into these measurements. Experiment confirmed this expectation. When the detector was screened on both faces by cadmium, the measurements of the activity with and without thorium (or with and without lead) gave the same values within the experimental error of 2–3 per cent. Further, in order to test the influence of inelastic scattering, the cadmium was placed by turns either directly on the exposed face of the detector (with the thorium put upon that), or between the neutron source and the thorium absorber. No difference could be detected. Thus the inelastic scattering does not give rise to thermal neutrons in any observable quantity, a result to be expected.

These results suggest that, under the conditions actually used, the scattering of thermal neutrons too will be negligible, and thus the decrease in activity (of about 28 per cent) caused by the thorium absorber is due to radiative capture processes only. To obtain a direct proof the absorption in metallic lead was measured. The lead absorber had practically the same dimensions as the thorium absorber, but the thickness of the cast lead prism of density 10·6 was kept a little smaller (1·10 cm) in order to have the same number of absorbing nuclei per cm.^{2}.

Of course, in determining the cross-sections, the angular distribution of the thermal neutrons was taken into account and obliquity corrections (angles up to nearly 70° were involved) were made according to the data given by Frisch[2].

The total cross-section for thermal neutrons in lead was found to be $\sigma^{th}_{\mathrm{Pb}} = 2 \cdot 5 \pm 0 \cdot 2 \times 10^{-24}$ cm.^{2}. This value is in very good agreement with the value of $2 \cdot 3 \times 10^{-24}$ cm.^{2} obtained by Fleischmann[3] from γ-ray measurements. Thus one can be sure that for thorium too the radiative capture cross-section alone enters into the measurements. The value obtained is $\sigma^{th}_{\mathrm{Th}} = 6 \cdot 0 \pm 0 \cdot 3 \times 10^{-24}$ cm.^{2}. This cross-section can be used to evaluate the capture cross-section of ^{238}U. In this isotope, as Bohr[4] has emphasized, thermal neutrons do not produce fission processes. Thus when equal small quantities of uranium and thorium are subjected to neutron bombardment under identical conditions, ^{239}U and ^{233}Th respectively being produced, it is clear that if on account of their nearly equal half-life the efficiency of the β-rays is assumed to be approximately the same, the β-ray activities due to thermal neutrons (corrected for equal numbers of nuclei) must be proportional to the respective cross-sections:

$$\frac{T^{th}_{\mathrm{U}(239)}}{T^{th}_{\mathrm{Th}(233)}} = \frac{\sigma^{th}_{\mathrm{U}(238)} \cdot \frac{1}{238}}{\sigma^{th}_{\mathrm{Th}} \cdot \frac{1}{232}}.$$

From earlier measurements carried out in Dahlem, I find for this ratio the value 1/4·15. Using the above value for the cross-section of thorium, the cross-section for uranium 238 is

$$\sigma^{th}_{\mathrm{U}(238)} = 1 \cdot 5 \pm 0 \cdot 2 \times 10^{-24}\ \mathrm{cm.}^2.$$

Anderson and Fermi[5], measuring directly the β-ray intensity of ^{239}U due to a known number of thermal neutrons, found

$$\sigma^{th}_{\mathrm{U}(238)} = 1 \cdot 2 \times 10^{-24}\ \mathrm{cm.}^2.$$

Considering the possibility of fairly large errors in this type of measurement, the agreement is very good.

I wish to express my gratitude to the Academy of Sciences for a grant and in particular to Prof. Siegbahn for the facilities kindly put at my disposal.

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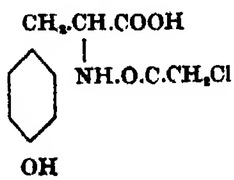
Mechanism of Catalysis by Enzymes

WHILE it is generally agreed that enzymes are true catalysts, the explanation of the mechanism of the reaction is still speculative.

In a previous paper[1] a theory was suggested to explain the catalysis and its reversibility. According to this theory the enzyme, having combined with its substrate, transmits to it a small quantity of energy which activates the substrate by altering the electron distribution in it. The altered electron distribution, by increasing the reactivity of the substrate, increases the reaction velocity. As the reaction proceeds and energy liberated by the formation of new bonds appears the energy borrowed from the enzyme is returned; the whole mechanism being reversible. While the picture is too static to be strictly accurate and while the mechanism of electron distribution alteration is speculative, it is to be expected from this theory that there would be a relation between the polar constitution of the substrate and the velocity of its hydrolysis in the presence of an enzyme. The electron distribution in a compound depends partly on its polarity.

Abderhalden and Abderhalden[2] have shown that in the presence of acylase, chloracetyl-tyrosine (I) is



I

hydrolysed faster than the corresponding bromo compound, which is hydrolysed faster than the corresponding iodo compound. The important difference between these compounds is the polar contribution of the halogen, which is strongest in the chloro compound and weakest in the iodo compound. This case shows clearly the important influence which substrate polarity has on the velocity of enzymatically catalysed reactions. Abderhalden and Abderhalden have also

shown that chloracetyl-, bromacetyl- and iodoacetyl-leucine under the influence of acylase behave similarly to the corresponding tyrosine compounds.

Glick[3], in studies on the specificity of choline esterase, has shown that halogenation of the acid component of acetylcholine increases the velocity of the catalysed reaction. He has also shown that halogenation of both radicals of ethylacetate considerably increases the velocity of the enzymatically catalysed reaction. Commenting on the fact that acetylcholine and chlorethylacetate are split at approximately the same speed, he states that it is peculiar that replacement of the positively polar methylamino group by the negatively polar Cl atom should not influence the reaction velocity. The fact that both these groups are electron attracting groups and exert negative inductive effects on the atoms of the link split explains this apparent anomaly. These examples from Glick's work also show the influence of substrate polarity on the velocity of enzyme action.

That substrate polarity is a factor determining quantitative enzyme specificity is clear from the marked effect which it has on the reaction velocity. Whether substrate polarity can be regarded as a factor determining absolute specificity remains to be seen.

Up to the present there have been many references in the literature to the importance of molecular polarity in biochemistry without any very clear reasons being given. When the influence of polarity on both the uncatalysed reaction (*cf* Hinshelwood *et al.*[4]) and on the catalysed reaction is borne in mind the significance of this factor becomes clear. For example, changes in the polarity of a drug or other compound can effect its solubility, the rate and magnitude of its action and the rate at which it is destroyed whether enzymatically or otherwise.

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Influence of Cell Wall Composition on the Moisture Relations of Hardwood Timbers

IT has already been shown that the compressive strength of hardwood timbers in the green condition is dependent on the degree of lignification as revealed by the behaviour of thin sections with micro-reagents. Thus tropical timbers, with their greater degree of lignification, are on the average stronger than temperate zone timbers of similar density, and the normal wood of temperate zone hardwoods is stronger than tension wood from leaning trees of the same species[1]. The difference in strength between normal and tension wood was found to be less pronounced in air-dry than in green wood[1], and this observation suggested that the influence of the degree of lignification is affected by the moisture content of the wood. In order to examine this possibility a scrutiny has been made of data in the records of this Laboratory or published by other institutions[2,3,4]. The data were taken as a whole, without the exclusion of particular species, and a comparison was made (*a*) between tropical and temperate zone timbers, and (*b*) between normal and tension wood, the influence of density being taken into consideration. In so far as differences in cell wall composition account for the differences between the properties of the timbers under comparison, our observations indicate that the proportional increase in strength which usually accompanies the drying of wood is less in strongly lignified than in weakly lignified material, and consequently differences in strength which are due to differing degrees of lignification tend to be reduced as wood dries. This provides a partial explanation of the fact that the relationship between compressive strength and density is much closer in air-dry than in green wood, particularly in the case of temperate zone timbers.

It was further observed that tropical timbers show a slightly, but significantly, smaller shrinkage both radially and tangentially than temperate zone timbers; they have on the average a lower fibre saturation point (as determined from measurements of shrinkage in drying wood), and reach equilibrium at a lower moisture content when placed in an atmosphere of 90 per cent relative humidity. At 60 per cent relative humidity, however, there is no significant difference between the equilibrium moisture contents of the two groups of timbers.

The data available for the comparison of normal wood with tension wood are very limited in amount, but so far as they go they appear to indicate a behaviour parallel to that of the tropical and temperate zone timbers. The only difference of note is that in two of the three species examined the normal wood showed a slightly *higher* equilibrium moisture content at 90 per cent relative humidity than the tension wood; in the third species no difference was detected. In view of the small number of samples available, however, this point requires further investigation.

It is thus apparent that the equilibrium moisture content, the shrinkage in passing from the green to the air-dry state, and the strength-density ratio in hardwood timbers are all dependent to some extent on the degree of lignification. The influence of the degree of lignification on strength, however, appears itself to be dependent on the moisture content. It is of practical significance that variation of certain properties tends to be reduced as wood dries from the green state to the condition in which it is ordinarily used.

Details of the investigation are contained in Project 18, Progress Report No. 11, copies of which will be obtainable from this Laboratory.

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Pigments of Sponges

THE lipochrome nature of the colouring matters of the Porifera or sponges was recognized by Krukenberg[1] who refers to their carotinoid-like and rhodophane-like pigments, the latter being characterized by the possession of a single absorption band. Later spectroscopic study of the pigments of additional species by MacMunn[2] confirmed these observations.

More recently, Karrer and Solmssen[3] have isolated the Crustacean pigment astacene from the sponge *Axinella crista-galli*. They claim that this pigment is also present in *Suberites domuncula*, but this is at variance with an earlier observation of Kuhn, Lederer and Deutsch[4]. No other crystalline carotinoid had so far been isolated from sponges.

We are at present engaged on an investigation of the pigments of the red sponge *Hymeniacidon Sanguineum* (Grant). We have failed to detect astacene but have isolated two carotinoids, echinenone and γ-carotene in crystalline form. We have also obtained spectroscopic evidence of the presence of α-carotene Echinenone was discovered by Lederer in 1935, who isolated it from the sea-urchin *Echinus esculentus*. Apart from β-carotene it was the first animal carotinoid found to possess vitamin A activity[5]

The demonstration of the presence of the pigment echinenone in sponges provides a chemical link between the otherwise unrelated Porifera and Echinodermata It would also appear that this is the first occasion on which γ-carotene has been isolated from invertebrates.

We hope to publish a detailed account of this investigation elsewhere.

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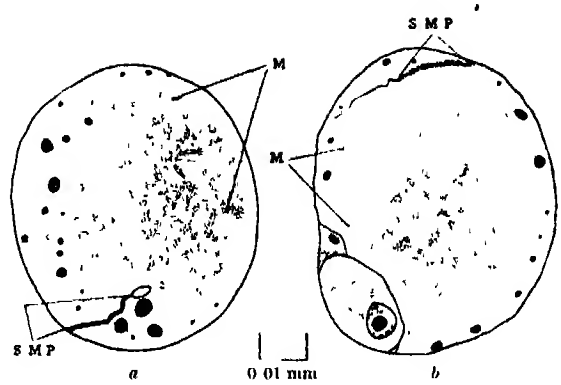
[5] NATURE, 137, 996 (1936)

Presence of the Sperm Middle-Piece in the Fertilized Egg of the Mouse (*Mus musculus*)

DURING an investigation of the cytoplasmic inclusions of the fertilized egg of the mouse, the sperm middle-piece, and in some cases the whole tail, was observed in the ooplasm (*a* and *b*). The middle-piece usually becomes detached from the sperm-head shortly after the entry of the sperm, but may remain attached until the stage of the pronuclei is reached The middle-piece is, at first, compact and deeply stained, but soon shows a granular structure. These granules are identified as the mitochondria of the sheath of the axial filament (*a*, *S.M.P.*). After the middle-piece is free of the sperm-head the sheath becomes less compact, so that the individual granules can be identified with ease (*b*, *S.M.P.*).

The sperm-mitochondria are slightly larger and are more deeply stained than those of the egg (*M*). At a later stage the mitochondria of the sperm stain in a similar manner to those of the egg; they now form a loose broad band, and are, later, distributed through the ooplasm.



Sperm-mitochondria were not identified during the later phases of the stage of the pronuclei, or during the first cleavage division, or in the two-cell stage.

It is concluded that the sperm-mitochondria become similar in size and staining properties to those of the egg, that they are distributed through the ooplasm and, later, become arranged around the spindle, together with the egg-mitochondria, and are consequently transmitted in approximately equal quantities to the first two blastomeres.

There is also evidence that the Golgi material of the sperm is carried into the egg It undergoes fragmentation and becomes indistinguishable from the Golgi elements already present in the egg

The present findings do not support the work of Lams[1], Levi[2], and Van der Stricht[3], who claim that the sperm-tail of certain mammals is segregated into one of the blastomeres of the two-cell stage.

So far as I am aware, distribution of the sperm-mitochondria through the ooplasm before the first cleavage division has not previously been recorded in the eggs of mammals. Held[4] and others, however, have traced the history of the sperm-mitochondria in the cytoplasm of the ova of certain invertebrates.

The present findings are based on the examination of material fixed in Flemming's fluid (without acetic), and of material treated according to the method of Aoyama. It is hoped to publish a detailed account of the history of the cytoplasmic inclusions of the sperm in the cytoplasm of the egg of the mouse.

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Jan. 31.

[1] Lams, H, *Arch Biol.*, 28 (1913)
[2] Levi, G, *Arch. Zellforsch*, 13 (1915)
[3] Van der Stricht, O, *Arch Biol*, 33 (1923)
[4] Held, H., *Arch Mikr Anat.*, 89 (1917)

Subjective Judgments of 'Firmness' in Elastic and Viscous Materials

IN the testing by handling of many industrial products showing both elastic and plastic properties (of which cheese is typical), direct comparisons of 'firmness' are regularly made, although the physical dimensions of the property assessed as 'firmness' are variable. (No satisfactory theory of psychological dimensions has yet been proposed though these certainly differ from physical dimensions.) A study of this phenomenon is being published elsewhere, and in the course of the work it was found that even in the extreme case of truly fluid bitumen cylinders and approximately elastic rubber cylinders of the same

size and shape, all the twenty subjects tested were able to give direct simultaneous comparisons for 'firmness'. With one exception, it was only after a considerable number of tests that subjects appreciated the dimensional difficulty, though 'firmness' has in the former material, the dimensions of a viscosity ($ML^{-1}T^{-1}$) and in the latter, those of a compression modulus ($ML^{-1}T^{-2}$).

It was also found that, over a considerable range of modulus and viscosity, a reversal in judgment could be produced by varying the time during which the handling was carried out. This effect was anticipated, since the dimensions of viscosity and compression modulus differ by T^{-1}, but it seemed worth while to carry out a quantitative experiment

For this purpose, two of our best subjects were chosen. They were given pairs of cylinders, one bitumen cylinder and one rubber (diameter 2·0 cm., height 2·5 cm.), one in each hand, and instructed to squeeze each pair twice in time to a metronome, to change hands, to squeeze twice again, and to give a judgment as to relative 'firmness'. Adequate precautions were taken to eliminate extraneous effects. Times of 0·5 sec. and 4·0 sec. were used, the order of the tests being randomized

First, a cylinder of truly fluid bitumen (viscosity, $10 \cdot 7 \times 10^6$ poises) was compared with a series of rubber cylinders (compression modulus range, $0 \cdot 78$–$1 \cdot 41 \times 10^7$ dynes/cm.^{2}). In a second experiment, a single rubber cylinder (modulus, $1 \cdot 53 \times 10^7$ dynes/cm.^{2}) was compared with a series of bitumen cylinders (viscosity range, $4 \cdot 6$–$19 \cdot 8 \times 10^6$ poises). The results of these tests are given in the accompanying table.

		Constant viscosity (bitumen) 4·0 sec	0·5 sec	Constant modulus (rubber) 4·0 sec	0·5 sec.
1 (male)	Bitumen softer	30	8	25	7
	Rubber softer	1	16	0	19
	Indistinguishable	1	13	7	6
2 (female)	Bitumen softer	31	9	24	15
	Rubber softer	1	23	8	17
	Indistinguishable	0	0	0	0

The effect of varying the pressure of handling was also tested, but found to be insignificant.

A detailed examination of the data summarized in the table indicates that for an eight-fold time difference, the range of viscosity over which a reversal of judgment can be obtained in comparing a series of fluids with a standard elastic sample, shows no marked difference from the range over which the compression modulus of elastic bodies can be varied to give reversals in comparison with a constant fluid sample Our previous work[1,2] has shown that the compression modulus of elastic materials can be judged subjectively some three times as accurately as can the viscosity of true fluids of the same order of 'firmness'. This depends on the fact that the elastic modulus can be judged statically whereas the viscosity demands a dynamic judgment. When elastic and viscous bodies are simultaneously compared, a dynamic judgment is required throughout.

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[1] NATURE, 143, 164; 144, 286 (1939).
[2] Proc. Roy. Soc., B, 128, 109 (1939).

The Nature of Time

IN a recent article, entitled "The Relativity of Time", Prof. Herbert Dingle[1] discussed what constitutes a clock, and he used the discussion to support a thesis which he stated at the outset, namely, that the restricted theory of relativity does not imply a Fitzgerald contraction of time intervals.

Prof. Dingle's conclusions in this regard are untenable, and in order to make clear the errors in his arguments, I shall first state some of the cardinal features of the restricted theory of relativity.

Two inertial systems $O.\ xyzt$ and $O.'\ x'\ y'\ z'\ t'$, with x-axes coinciding, are assumed to be moving relative to each other with a constant velocity, v, say. Then the co-ordinates x, y, z, t and x', y', z', t' are related by the Lorentz equations, and it follows that space intervals and time intervals in either system are reduced by the Fitzgerald contraction factor when observed by an observer at rest in the other system.

The time co-ordinate in each system is given by some cyclic or recurring phenomenon. Fundamentally its nature is that of a dial reading which indicates 'how many'. It is a reading which is observable by each observer in his own system, and is used to designate the temporal order and spacing of the reception and sending of signals.

Consider, then, Dingle's hour-glass type of clock, in which he says either the number of grains N, or the mass of sand MN, M being the mass of a grain, could equally well be regarded as measuring the time In the second alternative, however, it is not legitimate to measure the total mass in one system in terms of the unit mass of the other, and to use this as time measure, as Dingle has done. Without the Lorentz equations there would be no basis for making such measurements, and therefore the Lorentz equations could not be derived from observations based on time obtained from mass measurements of this kind. Such time measure is alien to relativity and is inconsistent with the Lorentz equations.

Mass could be used to measure time if the man at rest with the clock did the measuring in each case. Thus, if M were the mass of a grain in the first system as measured by an observer in that system, then M is also the mass of a grain in the second system as measured by an observer in the second system. Therefore, if N and N' are the number of grains observed in each, then the masses observed are MN and MN'; and therefore whether the number of grains or the mass of the sand is used as time measure, the clock ratio is the same, namely, N'/N.

Consider now Dingle's second type of ideal clock, namely, "a particle . . . moving freely along an infinite space-measuring scale in a region free from gravitational and other fields of force, the time . . . (being) the reading of the scale at the instantaneous position of the particle". Regarding two such clocks he says, "the time which the stationary clock takes to move over n divisions of its scale must be considered equal to the time which the moving clock takes to move over n divisions of *its* scale. But the latter scale is contracted. . . . Hence the particle of the moving clock moves a shorter distance in the same time; that is, the moving clock must be considered to be running slower than the stationary clock. . . ."

This reasoning is fallacious. For the scale readings *are* the times with which relativity deals, and by the Lorentz equations their rates of change in the two

systems are not equal. Also, to say that "the moving clock moves a shorter distance in the same time" is to define the time by the *distance* the moving particle has gone, and then to measure the distance on the *moving* scale by the unit length of the *stationary* scale. This is the same kind of error as was made in measuring the mass of sand in the moving system in terms of unit mass in the stationary system. The time in each system would be identified with the distance travelled by the moving particle if, and only if, the distance in each system were measured in terms of the unit of that system.

The question of the distortion of lengths and time intervals in relativity is one of some perplexity. In both cases it is manifested by light signals, but there is an important difference. In the case of rods, if they were of the same length when relatively at rest, they would appear distorted when in motion, but on coming to rest again they would show equality. In the case of the time intervals of separation, on the other hand, signals are continually received during the separation, and the time interval registered by the moving system is indicated by the accumulation of these signals The whole rod comes back simultaneously, but the record of the travelling clock is received over the whole interval of separation, and a signal once received is never eradicated.

Dingle says that the time distortion cannot be exhibited experimentally, and with that statement I agree. The special theory of relativity deals with uniform relative motion, and a body under such motion cannot make a 'return trip' from another body. But I have made an extension[2] of the Lorentz transformation to accelerated motion, and this extension makes it possible to consider a return trip. The validity of the extension is confirmed by the consistency of the results from the point of view of observers in the two systems, and also by their agreement with the treatment of time distortion by the general theory of relativity[3]. The conclusion is that while the rod on returning has the same length as the one which remained stationary, the total recorded time of this moving system is less than the total recorded time of the stationary system; that is, the time distortion is real.

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Jan. 30.

[1] NATURE, 144, 888 (1939).
[2] Campbell, *Phil. Mag.*, (vii), 16, 529 (1933).
[3] Campbell, *Phil. Mag.*, (vii), 15, 48 (1933).

I CANNOT accept Prof. Campbell's criticism, which seems to me to be inconsistent. Apparently he holds that the time of an event is, *by definition*, a dial reading ("Fundamentally its nature is that of a dial reading": "the scale readings *are* the times . . ."). He agrees, however, that "the time distortion cannot be exhibited experimentally". Hence there is no evidence for a change of dial reading (that is, of that which by definition is the time). What, then, is this "time distortion" which he accepts?

Prof. Campbell misrepresents me in his first paragraph. I did not say that a definite contraction of time intervals was not implied: I said that a moving clock would not necessarily exhibit such a contraction. In that lies the main point of my article, which was intended to remove a general notion that measuring time is identical with reading the dial of an unspecified instrument. This notion appears to be even wider-spread and deeper-seated than I imagined, and as I believe it to be erroneous, I venture to give my reasons at some length.

The fundamental unit of measurement in physics is the unit of length: it is the distance between two marks on a bar kept under fixed conditions The unit of time is the time taken by a specified moving body (one undisturbed by forces, according to Newton's First Law) to cover unit length. The unit of mass is defined in terms of the units of length and time (according to the principle of conservation of mass and momentum in elastic impact). All other units are chosen in terms of these The unit of length is thus the only one which is chosen without reference to any other unit.

It follows that while the distance between two points can be measured by taking a particular body—the standard bar (which is chosen with some arbitrariness, though not, of course, without regard to convenience and the simplicity of the relations in which measures of length take part)—and laying it along the line joining the points, each other physical quantity can be measured only by first constructing an instrument *according to the principle by which the unit is defined*, and then, if necessary, correcting its readings for any failure of the instrument to incarnate that principle in whatever particular circumstances it is used In making a measurement, therefore, we must discover not the dial reading but the reading which the dial would record if the principle were faithfully expressed.

The measurement of temperature affords a good example. On the air scale we define the unit interval of temperature as that which produces a given increment of volume in a given mass of air at constant pressure. The reading of the instrument rarely, if ever, corresponds to this, and we correct for expansion of the containing vessel, barometer variations, exposed stem, etc., to obtain the temperature according to the specified principle. There are other scales embodying other principles; for example, the mercury-in-glass scale, platinum resistance scale, etc. The readings of instruments intended to record these scales have similarly to be corrected, and the corrected results differ for the different scales. None of them, however, is the 'temperature' implied in physical theory. That is defined in terms of the 'absolute' or 'work' scale. It is impracticable to make an instrument which even imperfectly embodies the principle of this scale, so we use an air or other thermometer, and adjust its corrected reading to give the 'absolute' temperature.

Now this is very closely parallel to the measurement of time. The air thermometer may be compared with my 'volume-clock': the unit of time is that in which unit volume of sand falls. If the dial does not record this, then its reading must be corrected. The corrected 'mass-clock' and 'number-clock' readings similarly correspond to the corrected mercury-in-glass and platinum resistance thermometer readings, and they may differ from each other and from the volume-clock reading. None of them necessarily shows the 'time' of physical theory, for that is indicated by the 'ideal' clock, which corresponds to the absolute thermometer.

This is commonplace knowledge with regard to temperature, but so far as I know, no one has hitherto pointed it out with regard to time—possibly because all time scales happen to be identical in a single

co-ordinate system. Books on relativity usually say simply that a moving clock runs slow by a particular factor, leaving it to be inferred that anything that ticks and moves a pointer round a dial will visually display the Lorentz transformation It was the purpose of my article to show by examples that this was incorrect, and to discover to what 'clock' the transformation formula applied

Prof. Campbell maintains that in using a moving mass-clock the observer must move with the clock when measuring the mass but remain stationary when counting the grains Why this difference ? If he consistently moved with the clock he would obviously observe no effect of motion at all, but the action which Prof. Campbell prescribes for him seems a little arbitrary I suspect that Prof. Campbell has not completely shed the idea of absolute motion; otherwise I cannot account for his allowing N and N' to differ It is perhaps as well to point out again that, according to relativity, if an observer is initially at rest with respect to two identical instruments, and then one of them moves away from him, the 'change' in the indications of that instrument is exactly the same as if it were undisturbed and the observer, with the other instrument, moved with the same speed Which is N and which N' in that case ?

Finally, Prof Campbell seems to me to be quite wrong in objecting to, say, my mass-clock measurements on the ground that "Without the Lorentz equations there would be no basis for making such measurements". You do not need the Lorentz equations in order to measure mass The principles of mass measurement were defined before the Lorentz equations were thought of, and they are not to be changed because the observer decides to move while applying them.

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Unusual Ice Formation in Wiltshire

ON January 28 and 29, ice was formed in west Wiltshire under conditions unprecedented in the experience of local inhabitants: a record of the effects may have more than local interest.

January 27 had been a day of relative warmth and of heavy rain after a prolonged spell of frost

[Photo by O. W. Davies

and sunshine, and water collected over the frozen ground. The early morning of January 28 was also wet, there being a mild drizzle; but water was freezing under foot and the branches of trees crackled By midday, though rain continued, ice had become a conspicuous feature of the landscape. Blades of grass were embedded in needle-like sheaths, the taller stems in glass-like rods, and dead flower heads had given rise to ice flowers of beauty and delicacy. On hedgerows and trees, on roads, stone walls and wire fences, the same process was at work Everything, including threads of hair entangled on barbed wire, had become thickly coated; and trees acquired a fantastic appearance suggesting giant candelabra of crystal.

By January 29 the ice had thickened. Grass blades were no longer encased in needles but in thick fingers of ice, and fields became most uncomfortable to walk over. Where grass stood high amid erect heads of dock, plantain, napweed, yarrow, etc., they had become a growth of brittle ice-bound stems The weight of ice on trees and telegraph wires was now overwhelming and large boughs crashed to the ground

Accurate measurements of the ice were not made. It was formed on the exposed and on the upper sides of supporting surfaces In section, the fingers of ice were roughly elliptical, the original support occupying a position near the periphery in the longer axis Around telegraph wires the ice was, however, circular (*circa* $\frac{3}{4}$ in. in diameter) which suggests the wires had undergone torsion Icicles hung from some of the trees and from the eaves of buildings, but were not a conspicuous feature of the landscape.

Since the above was written a similar account of the same storm at Petersfield has been published by Cave[1] Comparison of the two suggests that ice formation in Wiltshire started some twelve hours later but followed the same course. Storms of the kind are evidently rare though on record[2,3,4] and information is scanty on their causative factors, on the growth of the ice, and on its effects upon living vegetation. The report[5] that on March 5 New York experienced the worst ice-storm for 25 years is also of interest

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[1] Cave, C J P, An Ice Storm, *The Times*, February 13, 1940
[2] Plebourg, P, Sur les effets produits, à Fontainbleau, par le verglas des 22, 23 et 24 janvier 1879, *Compt Rend. Acad. Sci.*, 1, 245 (1879)
[3] Godefroy, L, Le verglas du mois de janvier 1879, *Compt. Rend Acad Sci*, 1, 244 (1879)
[4] Pattinson, J., and Dines, J S, Glazed Frost, January 1940, *Met. Mag*, 75, No 889, p. 12
[5] *The Times*, March 6, 1940

Witwatersrand Local Tremors

IN an article on "The Earthquake in Turkey"[1] Mr. E. Tillotson refers to the idea that violent earthquake shocks appear to be followed almost immediately by sympathetic shocks in various parts of the world. In this relation he points out that on the same day as that on which the earthquake occurred in Turkey, December 27, 1939, earthquakes occurred in San Salvador, Los Angeles, Tangier and "Between December 27 and 28, twenty-five earthquakes and earth tremors . . . shook the gold mining district of the Rand near Johannesburg in South Africa".

The reference to the Witwatersrand may be misleading without further knowledge of the conditions prevailing there. Earthquakes do not occur on the Witwatersrand, but local tremors are of frequent occurrence. These tremors were unknown before 1908; they began then to attract attention and their numbers increased very rapidly for some years and then more slowly. The frequency of their occurrence has kept pace closely with the increase of mining activity. A statistical study of the Witwatersrand local tremors covering a period of twenty-seven years has recently been undertaken by Dr P. G. Gane of the Bernard Price Institute of Geophysical Research, Johannesburg[2]

Dr. Gane accepts the idea that the primary cause of these tremors is the local instability due to mining operations and has attempted to find 'trigger-forces' which might affect their actual occurrence. He concludes that blasting in the mines is likely to be by far the most effective trigger

During the year 1939, 2927 local tremors were recorded by the seismograph at the Union Observatory, Johannesburg Of this number, 286 were strong enough to be felt. There appears to be a tendency for the tremors to occur in groups Such a group was experienced on December 27–28, but the occurrence of a large number of tremors in one day is not a particularly outstanding event, and should not be considered as having any bearing on the question of sympathetic earthquakes without further investigation

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[1] NATURE, **145**, 13 (January 6, 1940)
[2] *J Chem Metall Mining Soc S Africa*, October 1939

Mutarotation of Gelatin

SUBSTANCES which exhibit optical activity in solution do so as a result of molecular dissymmetry, the most common cause of which is the presence of an asymmetric atom in the molecule. In the crystalline condition, optical activity may be exhibited by substances which do not contain dissymmetric molecules. In this case, the optical activity is due to a dissymmetric arrangement of the units which make up the crystal and disappears when the crystal is dissolved, because the structural dissymmetry is thus destroyed. Certain substances with dissymmetric molecules show a combination of these two effects, structural dissymmetry being superposed on the molecular dissymmetry in the crystalline condition.

These well-known facts have a bearing on the mutarotation of gelatin, that is, the change in optical rotatory power which is associated with the sol $\rightleftarrows$ gel transformation. The optical activity of the sol is derived from the asymmetric carbon atoms of the protein molecules In the gel, optical activity due to a dissymmetric arrangement of the protein molecules is superposed. The mutarotation therefore adds to the evidence that the protein molecules form an ordered, rather than a random, structure in the gel.

These views may have been implied by previous authors but they do not appear to have been explicitly stated.

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Points from Foregoing Letters

FROM combined X-ray and chemical evidence, W. T. Astbury and Florence O. Bell put forward a model for the molecular structure of the fibres of the collagen group. The average length per amino-acid residue in the direction of the fibre axis is about 2·85 A., and the intramolecular pattern requires no fewer than 288 residues in a row. Owing to the high content of proline and hydroxyproline the polypeptide chains are partly in a *cis*-configuration, as opposed to the rather longer *trans*-configuration of the β-proteins.

Experiments are described by L. Meitner which give the capture cross-sections for thermal neutrons in thorium and lead. Using the thorium capture cross-section and the ratio of β-ray activities of ^{239}U and ^{233}Th (under identical experimental conditions) due to thermal neutrons, the capture cross-section for thermal neutrons in ^{238}U is obtained as well.

A new conception concerning the effect of substrate polarity on the velocity of enzymatic catalysis is pointed out by D. B. Taylor. Substrate polarity is suggested as a factor influencing enzyme specificity. The significance of substrate polarity is discussed.

S. H. Clarke and C. B. Pettifor find that the equilibrium moisture content, the shrinkage during drying, and the strength-density ratio in hardwood timbers are apparently dependent on the degree of lignification as revealed by histological reagents; moreover, the influence of the degree of lignification on strength is itself dependent on the moisture content of the wood.

Two carotinoid pigments, echinenone and γ-carotene, have been isolated from the red sponge *Hymeniacidon Sanguineum* by P. J. Drumm and W. F. O'Connor. The Crustacean pigment astacene, hitherto the only carotinoid isolated from a member of the Porifera, was not present.

R. A. R Gresson finds that during fertilization the sperm middle-piece, and in some cases at least, the entire tail, is carried into the egg of the mouse. The mitochondria of the sheath of the axial filament become distributed through the ooplasm, and are presumably transmitted, in approximately equal numbers, to the first two blastomeres. There is evidence that the Golgi material of the sperm is also introduced into the egg; it undergoes fragmentation and becomes distributed through the cytoplasm.

G. W. Scott Blair and Miss F. M. V. Coppen find that direct subjective comparisons of 'firmness' can be made between elastic and fluid materials where the dimensions of 'firmness' vary by T^{-1}, but that a reversal of judgment is obtained over a wide range by varying the time of testing. The range is about the same whether the viscosity or the compression modulus is varied.

RESEARCH ITEMS

Ancient Gold-working Site in Rhodesia

A MIDDEN site on the Macardon Claims, West Nicolson, Gwanda District, Southern Rhodesia, discovered by Mrs. Winifred Macdonald and examined by her, produced material of no little interest which has been described by Neville Jones (*Trans. Rhodesia Sci. Assoc.*, 37; 1939). The size and thickness of the midden deposit suggest an occupation by one or two families for not more than fifty years. A flattish granite rock which outcrops on the surface is almost entirely covered by dolly-holes and was evidently used for the purpose of crushing the auriferous quartz mined in the vicinity. The crushing was done by means of pestles of diorite some of which were found still standing in the holes as the original inhabitants had left them. Most of the holes contained fragments of quartz broken to a size convenient for dollying. A little fine gold was obtained from the holes. Objects found included a portable crushing mortar, hammers, gold in the form of beads, cylindrical and tubular, foil, tacks, links, etc., twisted copper wire, copper chain fragments and links, copper beads and needle, objects of iron, including battle axes, imported celadon ware, beads and bored sea-shells (Polinices, Cypræa and Oliva), locally made ornaments of soapstone, beads of ivory, ostrich shell, achatina shell, amulets, pottery and a portion of a tuyère for ore reduction and slag. The gold beads are significant for methods of manufacture. From the evidence of the pottery, which is of the Sotho and Shona traditions, the celadon, the beads and the association of gold objects, it is probable that the Macardon site is to be dated at about the close of the fifteenth century.

The 'Ultra-Perceptive' Faculty

THE existence of an 'ultra-perceptive' faculty, that is, the extension of perception beyond the normal and intellectual range, is not proved, but the scientific study of such perception has during the last few years received a fresh impetus. A paper by Dr. J. Hettinger, prepared for the Dundee meeting of the British Association, gives an account of an attempt to test statistically the probability of such a faculty. More than 150 subjects took part in the experiments which were carried out with the assistance of two professional 'sensitives'. Articles obtained from the subjects were placed in separate sealed envelopes and taken by the experimenter to the residence of the sensitives; one of the sensitives handled the envelopes while the other merely concentrated on the envelope laid on the table. The 'sensitive' then commented on the subject owning the particular article; for example, concentrating on one article, the sensitive said, "Pile of shillings, as if saved for some purpose". The subject with reference to this said, "I was counting the takings in a shop at the time, and had silver in piles." As a control, for each item given with regard to a particular subject by the sensitive an equal number of fictitious items was presented for acceptance or rejection. The results were treated to a detailed statistical analysis, and it was found that the deviation from chance expectation was more than fourteen times the probable error, indicating the probable existence of an ultra-perceptive faculty.

Age of Wild Birds of Prey

IN a short paper E. Lowell Sumner, jun., gives the ages attained by representatives of a few species of raptorial birds which had been ringed by him during the past fifteen years (*Condor*, 42, 39; Jan. 1940). The greatest age was attained by a screech-owl, *Otus asio quercinus*, which was shot thirteen years after ringing, and the average age of five returns of this species was 5 years. A barn-owl, *Tyto alba pratincola*, lived for 10 years 4 months, and the average of eleven returns was 3 years 2 months; two horned owls, *Bubo virginianus pacificus*, almost equal in age, averaged 2 years 6 months. The diurnal birds of prey seem to have rather shorter spans. Of four recovered red-tail hawks, *Buteo borealis calurus*, the oldest had survived for 1 year 5 months, and the average was only 7½ months. One Canadian golden eagle was captured at least 3 years 10 months old, and one sparrow-hawk, *Falco sparverius*, at 2 years 7 months. The numbers ringed and recovered in this experiment are too small to give a reliable indication of either average or maximum age, but the distances at which the birds were recovered suggest the relative tendency to wander. The four red-tails were captured at an average distance from the ringing place of 69 miles, the single golden eagle and sparrow-hawk respectively at 23 and 10 miles, the eleven barn-owls averaged 21 miles, as against one mile for the five screech-owls, whereas the single long-eared owl recaptured had travelled 49 miles.

Toxicity of Selenium-containing Plants to Pests

AMONG papers read before the annual meeting of the American Association for the Advancement of Science, which took place at Columbus (Ohio) at the end of December last are two on the above subject. V. H. Morris, C. R. Neiswander and J. D. Sayre discussed a method of rendering corn plants resistant to red spider attacks by growing them in nutrient solution to which was added each week 1 p.p.m. of sodium selenate. When the rate of selenium application was increased to 2 or 3 p.p.m., no red spiders were found to survive. Under such conditions the growth and normal nutrition of the plants was unaffected. Similar results have been obtained in additional tests with a number of other species of plants. In the second communication Messrs. Neiswander and Morris described results of experiments indicating that an accumulation of 90–100 parts per million of selenium in the tissues of certain plants was sufficient to prevent infestation by the common spider, *Tetranychus telarius*, and that a lesser amount controlled the chrysanthemum aphid *Macrosiphoniella sanborni*. The investigation suggests a possible method for controlling pests of ornamental plants.

Viruses and their Insect Vectors

THE complex relations which exist between a plant virus and the insect which transmits it have been studied by M. A. Watson and F. M. Roberts (*Proc. Roy. Soc. Lond.*, B, 127, 543–576; 1939). They used three viruses, namely, potato virus 'Y', cucumber virus 1 and Hyoscyamus virus 3, which cannot be transmitted mechanically and are non-persistent

in the insects which transfer them. Three species of aphid were used as vectors: *Myzus persicæ*, *M. circumflexus* and *Macrosiphum gei*; their efficiency in transmitting the viruses increased with increasing time of fasting before feeding upon infected plants, and decreased as the time of feeding upon the diseased hosts increased. It would therefore appear that the viruses are inactivated by some substance produced by the aphids when feeding. *Myzus persicæ* was the most successful vector, but the efficiency of each aphid varied according to the concentration and localization of virus in the plant, and to the inhibitive capacity of the insect for the virus.

Erosion Surfaces in the Allegheny Plateau

AT the annual meeting of the American Association for the Advancement of Science, during December last, J. L. Rich presented an illuminating paper on the identification and interpretation of erosion surfaces. Aerial photographs of selected parts of the Allegheny plateau were used to illustrate the thesis that projected profiles or visual inspection of skyline elevations cannot be relied upon for the determination of the altitude of an erosion surface unless the region has not passed beyond the mature stage of the cycle of erosion. For all post-mature stages an indeterminate amount of elevation must have been lost by the inter-valley divides. Physiographic evidence proves an enormous difference in the rate of erosion between certain shale horizons in the Pennsylvanian and the massive Pottsville conglomeratic sandstone at its base. The difference is such that two or more cycles can be brought to old age stage on the shales, while the first cycle has scarcely passed infancy on the sandstone. In view of these complications, due to rock resistance and its bearing on the stage reached in the erosion cycle, it is clear that a re-examination of the physiography of the plateau is called for.

Decomposition of Azomethane

THE decomposition of azomethane yields different products depending on the procedure employed. Emmett and Harkness (*J. Amer. Chem. Soc.*, 54, 538; 1932) found that catalytic decomposition using an iron (synthetic ammonia) catalyst gave methylamine as an intermediate product and ammonia, hydrogen and carbon as principal end products, while Taylor and Jahn (*J. Chem. Phys.*, 7, 470; 1939) found that pyrolysis and photolysis gave initially methyl radicals which added on to azomethane molecules forming tetramethylhydrazine, which afterwards decomposed. Recently, Henkin and H. A. Taylor have reported data (*ibid.*, 8, 1; 1940) on the decomposition of azomethane by atomic hydrogen at 27°, 110°, and 195°. At 27°, gaseous products were absent. A liquid product, obtained in a liquid nitrogen trap, contained a small fraction volatile at −78°, which was probably unchanged azomethane. The non-volatile liquid component, which was, therefore, presumably the sole product of the reaction, was colourless, basic, and a good reducing reagent. It gave the azo-cuprous chloride complex characteristic of a secondary hydrazine, and microanalysis of the picrate and oxalate showed it to be *s*-dimethylhydrazine. The absence of hydrocarbons indicates the non-rupture of the azomethane molecule. At 110°, methane and ethane were present (10 : 1). A considerable proportion of the liquid product was volatile at −78°, and combustion tests on the gas indicated methylamine. The residual liquid was again dimethylhydrazine. The liquid product from the 195° decomposition contained a larger amount of methylamine; the ethane yield was almost zero, and the amount of methane was only 20 per cent of that at 110°. Analysis of the fraction non-volatile at −78° indicated a compound with a nitrogen content lower than dimethylhydrazine. This is explained by assuming that methyl radicals join to azomethane molecules, with the ultimate production of tetramethylhydrazine and trimethylhydrazine. The possible mechanisms involved at the different temperatures are discussed.

Diffraction of Protons by Vapours

DETERMINATION of molecular structure by electron diffraction is now a well-established method. Provided that a suitable source and technique could be developed, the diffraction of protons by vapours is an extension of this method of great potentiality, since the intensity of scattering of protons by an atom should be about 2,000 times greater than the scattering of electrons. Light molecules could then be investigated. A first attempt in this direction is reported by H. J. Yearian (*J. Chem. Phys*, 8, 24; 1940), who describes an apparatus and preliminary results on carbon tetrachloride which agree satisfactorily with electron diffraction data. An arc of 0·5–2·0 amp. is struck in hydrogen in a stainless steel ion source and the ions are accelerated to 1·5–2·0 kv. The beam (approximate composition, 20 per cent H_1^+, 50 per cent H_2^+, 20 per cent H_3^+, 10 per cent heavy ions) is resolved into its ionic constituents by a magnetic field and the selected beam, after suitable focusing, falls on a stream of vapour at 10^{-4} mm pressure. The scattering is recorded photographically. Many difficulties of technique were encountered, principally space charge effects near the ion source, neutralization of the beam by molecules of the vapour, loss of sensitivity of the photographic film due to outgassing. Precautions taken to minimize these and other difficulties are discussed. The experience gained in these preliminary experiments has indicated certain desirable modifications of technique, which are outlined. This investigation may well be the precursor of an important new method of elucidating the structure of molecules.

Age of a Meteorite

A SHOWER of fragments of a stony meteorite which fell in Putulsk (Poland) in 1868 were supposed, on account of the reported high heliocentric velocity, to be extra-solar material, although this result is not confirmed by recent recalculation (C. C. Wylie, *Science*, 9, 264; 1939). The protactinium contents of this meteorite and of a granite low in radioactive material as representative of terrestrial material of similar composition have been determined by W. C. Schumb, R. D. Evans and J. L. Hastings (*J. Amer. Chem. Soc.*, 61, 3451; 1939) and the protactinium/radium weight ratios found. From the results the conclusion is reached that within the limits of error the age of the uranium atoms in this specimen of the Putulsk meteorite is the same as for terrestrial uranium. The protactinium was determined by co-precipitation with zirconium phosphate, followed by purification of the ignited pyrophosphate, the alpha-ray activity being measured on a recording alpha-ray counter. The method will determine as little as 10^{-13} gm. of palladium per gm. of siliceous material.

SEA FISHERIES OF EUROPE

ONE of the most valuable as well as the most generally interesting of the various publications of the Conseil Pérmanent International pour l'Exploration de la Mer is its *Statistical Bulletin*, in which are tabulated extensive and detailed statistics relating to the sea fisheries of the maritime countries of northern and western Europe. Even in normal times, such ample and diverse data require much time and labour to assemble and work up. But in the recent years of economic instability and wildly fluctuating currency values the difficulties of such work have very greatly increased. Nevertheless, by the diligence and resourcefulness of the editor and his staff, they have all been heroically met and successfully overcome, and volume 27, presenting the data for the year 1937, has recently been published*. In order to facilitate interpretation of the mass of detailed tables, a very comprehensive and extremely lucid summary of the main conclusions to be drawn from them is given—as in previous years.

The total quantity of fish landed in 1937 from all the sea fisheries of northern and western Europe (omitting Russia but including Iceland and Faroe) was more by about 4 per cent than in the preceding year; but for the nine principal countries the gain over the preceding year was no more than 2 per cent. For these nine countries the total landings were 32 per cent above the total landings in 1913, the last year prior to the War of 1914–18, which has long been used as a standard of comparison. (Table 1.)

From the British point of view the most comforting information contained in the *Bulletin* is that England, after many unsatisfactory years, at last showed an appreciable increase in landings with a rise of 7 per cent in the total catch in 1937 over 1936. But by far the largest increase was shown by Iceland with 27 per cent increase, followed by Holland with 15 per cent and Germany with 11 per cent. Both the German and English increases are shown to be due in large measure to the opening up of the Arctic trawl fishery at Bear Island and Spitsbergen.

TABLE 1

TOTAL QUANTITY OF FISH LANDED (IN '000,000 KILOS OR 1,000 TONS) AND PERCENTAGE RATIO TO 1913

	Total quantity				Ratio to 1913			
	1913	1935	1936	1937	1913	1935	1936	1937
England	820·5	729·9	804·0	865·4	100	89	98	105
Norway	731·5	1036·6	1146·9	1045·2	100	141	157	142
Scotland	397·6	279·7	257·3	238·8	100	70	65	60
France	193·2	284·0	275·3	313·4	100	147	143	162
Germany	181·4	468·9	569·0	632·6	100	259	314	349
Holland	147·1	119·0	160·4	185·6	100	81	109	126
Sweden	72·8	104·8	110·1	119·1	100	143	151	164
Denmark	64·4	83·5	83·6	85·5	100	130	130	133
Ireland[1]	31·4	11·4	11·5	12·8	100	33	33	37
9 countries	2642·9	3097·8	3418·1	3488·4	100	117	129	132
Iceland	92·2	266·1	261·0	332·7	100	288	283	361
Faroe Island	22·4	49·5	44·0	57·7	100	221	196	258
Finland	15·7	23·5	28·2	28·6	100	150	180	182
Belgium	13·1	36·3	36·8	35·2	100	277	281	269
13 countries	2786·3	3473·2	3788·1	3942·0	100	125	136	141

[1] Eire and Northern Ireland.

TABLE 2

ESTIMATED VALUE PER 100 KILOS (IN PRE-WAR SHILLINGS[1]) AND PERCENTAGE-RATIO TO 1913

	Value				Ratio to 1913			
	1913	1935	1936	1937	1913	1935	1936	1937
England	24·4	30·9	26·3	21·3	100	127	108	87
Norway	8·3	6·3	5·7	6·1	100	76	69	73
Scotland	19·7	26·0	26·0	22·2	100	132	132	113
France	50·4	49·7	49·4	38·2	100	99	98	76
Germany	25·0	17·5	17·4	15·0	100	70	70	60
Holland	27·1	21·0	18·2	15·4	100	78	67	57
Sweden	23·9	24·6	21·6	17·7	100	103	90	74
Denmark	29·6	36·8	34·4	30·3	100	124	116	102
Ireland[2]	17·2	27·2	25·2	20·3	100	158	147	118
9 countries	21·3	21·4	19·1	17·0	100	100	90	80
Iceland	11·5	4·5[3]	3·9[3]	3·8[3]	100	39[3]	34[3]	33[3]
Faroe Island	12·1	10·4	8·9	7·6	100	87	74	63
Finland	28·7	28·9	25·6	20·6	100	101	89	72
Belgium	36·6	36·9	38·6	35·8	100	101	105	98
13 countries	21·1	20·1	18·2	16·0	100	95	86	76

[1] Estimate based on wholesale price-index from year to year in accordance with the principles adopted by Nellemose in *Rapp et Proc.-Verb.*, 93. "A Review of Fishery Statistics in Relation to Wholesale-Index".

[2] Eire and Northern Ireland.

[3] Reduction too great; cost-of-living index used in lieu of wholesale index.

Concerning Scotland, however, the all too dismal tale, continued over many years, has once again to be told. For more than ten years previous to 1937 the Scottish landings had been diminishing and in that year they had fallen to less than two thirds (60 per cent) of those of 1913, and were 7 per cent less than those of 1936. Only two other countries showed diminished landings in 1937 as compared with 1936—Norway by a little and Belgium by about 5 per cent. Nevertheless, both these countries landed much more fish than in 1913—the former 1½ times and the latter 2½ times the 1913 total.

The most outstanding changes in the share of the total catch taken by each of the principal countries were shown by the British and German landings. Once more comparing 1913 with 1937, it is found that the combined shares of England, Scotland and Ireland had fallen from 45 per cent to 28·5 per cent, while Germany's share had risen from 6·5 per cent to 16·2 per cent of the whole.

In spite of formidable difficulties in ascertaining, computing, and comparing the values of the catches in the different countries, and the still greater difficulty of finding a basis of comparison with the values of former years, the attempt has been made and careful estimates based on price indexes, are presented. This done and the price of fish adjusted to the general price index, the surprising fact emerges that the value of fish per kilo, at least until 1936, appears to have changed very little since before the War of 1914–18; that is, whatever the apparent changes in market prices may have been, the *relative* price of fish remained much as before. Germany and Holland, however, were an exception, for in those countries the adjusted fish prices were much lower in 1936 than

* *Bulletin Statistique des Pêches Maritimes des Pays du Nord et de l'Ouest de l'Europe.* Rédigé par Sir D'Arcy Wentworth Thompson. Vol. 27 (pour l'Année, 1937). København: Andr. Fred. Høst and Fils). Kr. 3.00.

in immediately preceding years and notably lower than in 1913, probably because in these two countries the markets were better supplied than formerly and fish had become a more plentiful and cheaper food.

A still more curious and surprising thing is that the adjusted prices of 1937, as compared with those of 1913, were lower in all countries except Scotland, Ireland, and Denmark In the first two countries fish prices appeared to remain considerably above the 1913 level; and in Denmark, although decreased by about 20 per cent in two years, they still remained above the pre-War level. In all other countries, and most notably in Germany and Holland, fish appears to have been considerably cheaper in 1937 than in 1913. In Table 2, where the prices in recent years are given and also their percentage ratio of the 1913 values, the all but universal reduction in fish prices between 1935 and 1937 is very conspicuous. No explanation of this very remarkable fact is attempted.

From these and many other equally interesting general considerations, the *Bulletin* proceeds to give more specialized information concerning such matters as the landings of different fishes, and groups of fishes, from the numerous fishing grounds; the shares of the various participating countries in these landings; and even the seasonal fluctuations in the mean monthly landings of certain fishes of special importance, for example, plaice and sole, from the North Sea and elsewhere.

For all those with any interest in fish or fisheries, whether from the scientific or commercial point of view, the *Statistical Bulletin* is a mine of useful information most attractively presented. Not least among the many harmful results of the present War will be yet another interruption in the continuity of much of the data upon which the *Bulletin* is based.

AERIAL, GEOLOGICAL AND GEOPHYSICAL SURVEY OF NORTHERN AUSTRALIA

BY DR. L. DUDLEY STAMP

FOR roughly a century the development of tropical Australia proceeded in an atmosphere of unqualified optimism. It was almost universally believed that only capital and enterprise were needed to render richly productive of minerals and agricultural wealth the vast untenanted northern half of the continent. Agricultural successes on the well-watered coast of Queensland were used to discount a dismal succession of failures elsewhere, and a few highly successful mining enterprises caused a willing public to forget many failures. Within the last fifteen years a professor in an Australian university who dared suggest that tropical Australia was far from being an El Dorado and in any event could only be developed by permitting coloured immigrants was so pilloried by the Press that he sought refuge in resignation. But the negligible return for a huge expenditure of public money at last rendered inevitable the conclusion that all was not well, and the long reign of optimism was succeeded by a period of extreme pessimism.

In the last few years has come the realization that the whole problem of tropical Australia needs to be examined scientifically and without prejudice, using all the weapons at the command of the modern investigator. In that spirit the three Governments concerned—the Governments of the Commonwealth, Queensland and Western Australia—agreed to inaugurate a survey with the object of seeking new mineral resources in the parts of the continent lying north of 22° S. £150,000 was provided—half by the Commonwealth Government, a quarter each by the other two—and it was intended originally to devote three years to the work. It was the first time in the history of Australia that three Governments had pooled their resources for such an investigation. On September 19, 1934, a party of four (Mr. P. B. Nye, executive officer of the Survey, Mr. L. C. Ball, Queensland, Mr. F. G. Forman, Western Australia, and Dr. W. G. Woolnough, Commonwealth geological adviser) set out on a preliminary reconnaissance flight of 12,000 miles to determine areas suitable for investigation. It was agreed that out of more than a million square miles approximately some 10,000 square miles could reasonably be covered in three years, the survey being confined to metallic minerals, particularly gold. Survey work actually began in May 1935 and falls into three parts. Aerial photography was carried out by the Royal Australian Air Force; ground surveys by three parties (in Queensland, Northern Territory and Western Australia respectively); geophysical surveys in selected areas were at first carried out under contract by the Electrical Prospecting Company of Sweden (Mr. Sepp Horvath) and later by the Survey staff itself.

The Survey has issued comprehensive progress reports every six months, beginning with a combined one for the whole period ended December 31, 1935. Those for the periods ended December 1935, 1936 and 1937 are particularly valuable as general summaries, and in the last it was pointed out that the work was far from complete and that it was to be continued during 1938. The detailed results are contained in the individual reports, of which there are thirty-nine for Western Australia, thirty-seven for the Northern Territory and thirty-five for Queensland, though all are not yet published. These 111 reports follow a uniform plan: all are issued by the Government Printer, Canberra, they are in foolscap size with appropriate maps, and set out the facts, favourable or unfavourable, on which private enterprise may assess the possibilities. Many are short—a page or two of text—and naturally most deal with ore fields previously known.

A particularly interesting report is Queensland No. 9—on the Croydon-Golden Gate area which was formerly one of the chief gold producers of Queensland and yielded £3,000,000 worth of gold before

being closed down some years ago. It was hoped that geophysical methods would lead to the discovery of new reefs beneath the cover of Cretaceous sandstones, laterite and alluvium. The methods used—electromagnetic, self-potential, magnetic—are described, and here the electromagnetic was found most successful and disclosed numerous good conductors considered to arise from reef-channels at depths corresponding approximately to water-level. The Survey was empowered to carry out shallow tests but not drilling, and so further work is left to private enterprise.

Report No 17 of the Northern Territory on the Fletcher's Gully Area, Daly River, may be selected as illustrating a type of history all too common. Traces of gold were discovered in 1905 in almost uninhabited country 100 miles south of Darwin. A 'gold rush' of about thirty miners followed, but in three months only two remained—working stream tin—and the claims were soon abandoned. In 1909 a group of Chinese got 183 ounces of gold by steady work, but in 1910 the area was declared a 'goldfield' and the Chinese had to leave The field was again abandoned after a few months. In 1912 the Chinese returned. In 1918 a new serious start was made by erecting a battery, but it apparently was never used. In 1926–29 there was a little spasmodic working by a few old Chinese. Now the Survey discloses small sub-horizontal reefs, some possibly with payable values, but does not encourage further work.

In some reports comes the thrill of new discoveries. Queensland No. 12 deals with an area in Cape York Peninsula, proclaimed a goldfield in October 1936 and surveyed in the following months. Even there the old type of prospector had penetrated so long ago as 1878 and may have assessed the true value of a mineral field, which now promises to be more important for its iron ore.

It is impossible, in the course of a brief review, to do more than indicate the existence of these valuable reports and to congratulate all concerned on the solid work they have carried out—especially Sir Herbert Gepp, the director, Messrs. Ball, Forman and Pye, his executive committee, and Messrs. C. S. Honman, P. S. Hossfeld, K. J. Finucane, R. F. Thyer, E L. Blazey and their assistants, of the field staff.

BROADCASTING OVER WIRES

THE idea of conveying speech and music programmes over a wire network is by no means new in Great Britain, for so early as 1895, the Electrophone Company provided a service to telephone subscribers by special connexion to theatres, music halls and churches Until a few years ago, however, no serious development had taken place owing to the indifferent quality of the service, the absence of suitable loud speakers and amplifying equipment, and the lack of public demand resulting from the relatively high cost involved. The introduction and success of radio broadcasting, accompanied by revolutionary developments in technique and equipment, have caused renewed attention to be given to the possibilities of diffusing programmes over wire networks For some years past a number of relay companies have been re-distributing the ordinary broadcast programmes over special wire network systems to subscribers who prefer this mode of reception to that involving the use of a normal receiver.

On March 30, 1939, the Postmaster-General announced that the Post Office was contemplating the introduction of a system of distributing broadcasting programmes over the line telephone network, as a service additional to that of the existing relay companies (see NATURE, April 8, 1939, p. 592). In a paper read before the Wireless Section of the Institution of Electrical Engineers on March 7, Dr. T. Walmsley gave an account of the technical progress made in this subject up to the outbreak of the War, by the Wire Broadcasting Branch of the General Post Office. After referring to the fact that the wire broadcasting system is likely to be relatively free from the various types of interference to which radio broadcasting is subject, the paper presented a detailed consideration of both the principles and the technique involved in distributing over wires at either audio or radio frequencies.

While the audio frequency system of distribution could make use of existing telephone lines, considerable interference with other telephone circuits would result if the electrical energy were transmitted over the lines at a sufficient level to operate loud-speakers direct Thus either the energy level must be reduced and an amplifier used on the listener's premises, or a special wire network must be employed. The latter system is the more satisfactory and has been more widely used up to date. Two arrangements of the scheme are possible; the first provides a separate pair of wires for each programme from the distribution station to a selector switch at the listener's premises; while the second provides several programmes over one pair of wires to the listener, who, by means of a special switch, is enabled by remote control to select one of several programmes available at the distribution station. Which of the two is the more suitable depends largely upon local conditions, the geographical distribution of the subscribers, and the relative costs of the switching systems and the installation of the necessary lines. The remote switching system has many interesting technical features, which are fully described in the paper.

The chief attraction of the distribution systems involving carrier or radio frequencies lies in the fact that the existing electricity supply or telephone networks may be utilized, with a consequent saving in line plant costs. The fact that the electricity supply networks in Great Britain are connected to a larger number of premises than the telephone network constitutes the chief advantage of their utilization for distribution of programmes at carrier frequencies. This advantage has, however, limitations set by technical problems such as insulation, so more attention has been given to the use of telephone lines for this purpose. By choosing the carrier frequencies to be within the normal radio broadcasting band, the subscriber can conveniently use a normal commercial broadcasting receiver, the various programmes available over the telephone system being selected by tuning the receiver to certain assigned radio

frequencies. The switch at the listener's premises is naturally provided with a change-over position in which the receiver is connected to a suitable aerial for reception of other broadcast programmes in the usual manner.

Dr. Walmsley's paper described the technical development of the equipment which has resulted in this method being placed on a satisfactory and practical basis. The reading of the paper was accompanied by a demonstration of the reception of both normal broadcasting and of special programmes over the standard Post Office telephone lines, using both the audio and radio frequency methods described. In the latter case, the reception is unimpaired by the use of the subscriber's telephone for a call and conversation in the usual manner. R. L. S-R.

RITUAL IN TIKOPIA OF THE SOLOMONS*

IN the first volume of his account of the ritual cycle known as "The Work of the Gods" in Tikopia, an isolated community in the British Solomon Islands Protectorate, Prof. Raymond Firth has confined himself mainly to giving an ethnographical account, reserving for later publication the major part of theoretical interpretation. In his introductory remarks, however, after pointing out that this, the most spectacular of his discoveries, had been mentioned only by the Rev. H. J. Durrad and Dr. H. R Rivers without any hint that they were anything more than isolated performances, he goes on to indicate its basic significance for the understanding of Tikopia, while its analogies with rites in Hawaii and Tonga suggest interpretations of these latter, which cannot be inferred from the existing fragmentary and obscure accounts.

The rites fall into several main divisions: a symbolic set to initiate the cycle; a resacralization of canoes; a reconsecration of temples; a series of harvest and planting rites for the rain; a sacred dance festival; several memorial rites and the rites of vanished temples; and in the trade wind season, the ritual manufacture of turmeric. The rites are one of the most elaborate expressions of the system of rank and of the religious beliefs of the people; it has important economic aspects, is related to the institution of marriage, sets the formal seal on fundamental forms of recreation, and provides sanctions for many of the most basic values.

The concrete title "The Work of the Gods" embodies two concepts: first that of a religious sanction, and secondly that of the ritual as a series of obligations involving the expenditure of goods and time. The religious sanction lies in the fact that the ritual cycle is believed to have been instituted primarily by one deity, the principal god of Kafika, who at the same time is worshipped by the chiefs of the other three clans; but into the scheme are drawn also other gods and chiefly ancestors. There is no elaborate mythology to explain how the ritual cycle came into being. There is a strong reverence for the ritual and the sacred objects connected with it.

The important matter of fixing the exact day on which the rites shall begin throws a significant light on the calendrical system and astronomical knowledge of Tikopia. The people have no fixed calendar and no names for the months or for the days or nights of the month. They count moons or nights of the moon for specific purposes, as in estimating pregnancy or periods between events. The term *tau*, meaning a 'measurement' or 'count', is used for a season, or sometimes a year as a whole, but without precision. Sometimes a *tau* has six months, sometimes seven. It is a seasonal period rather than a calendar period and refers primarily to the most marked climatic phenomenon in the island, namely, the alternation of the trade wind with the monsoon season. The seasonal changes, which are accompanied by changes in economic pursuits such as fishing, are the main basis for the seasonal ritual, as shown by the terms "The Work of the Trade Wind" and "The Work of the Monsoon". The trade wind begins to blow at about April and dies down in October, when the monsoon season begins.

Although the main index for the beginning is thus given by seasonal change, it is correlated with and corroborated by other factors. Though the Tikopia have no sidereal calendar, they use astronomical observation to a certain extent in time reckoning. Thus when the Pleiades rise, "the ocean has begun to bite", that is, the fish rise and are plentiful. It was said that when the Pleiades appeared above the sea in the east at dawn, it was the signal for the work of the trade wind to begin. At this time Taro, another star, stood high up at dawn. The work of the monsoon is also so guided. When Manu, a bright star, has passed the zenith in the evening, it is time to throw the firestick, for the season's work has arrived. Saraporu, another prominent star, stands midway in the western heavens in the evening at this time, but towards the end of the festival, when the dance festival begins, Saraporu has gone below the horizon. Tokens of the approach of the work of the monsoon season are also given by the migrations of birds and changes in vegetation.

The order of the rites of the Work of the Gods is traditionally fixed, though the space between them to some extent is at the discretion of the Ariki Kafika. But any ordinary Tikopia knows the sequence, and the full cycle in the traditional form shows that any man, not responsible for the organization of the rites, can carry in his memory a sequence of more than thirty days.

The Christianization of the Ariki Kafika, who took precedence over the other three chiefs in the rites, has brought about certain changes and adjustments. In the course of generations, such variation may become part of the traditionally accepted practice. This with the conseveration of other variations and causes of variation suggests the reflexion that "Polynesian culture must not be regarded as a static arrangement resting upon an original fusion of diverse elements, but as a dynamic arrangement with a tendency to variation perceptible in each generation, and with a selective process by which some at least of these variations are built into the cultural system".

* The Work of the Gods in Tikopia. By Raymond Firth. (Published for the London School of Economics and Political Science.) Vol. 1. (Monographs on Social Anthropology, No. 1.) Pp. vi+188+8 plates. (London: Percy Lund, Humphries and Co., Ltd., 1940.) 7s. 6d.

SEVENTY YEARS AGO

NATURE, vol. 1, March 17, 1870

The Geological Calculus

IN a letter under this title, [Sir] W. Boyd Dawkins, F.R.S., discusses the recent articles by Alfred Russel Wallace on the measurement of geological time. He concludes:

"But can we measure geological time by the lapse of years? If so, we shall have solved a problem infinitely harder than that which has foiled the archæologists. Can they fix the date, say of the introduction of iron into Europe, or of the dawn of the age of bronze or of stone? No man would venture to answer yes . . ." If, then, we are ignorant of the dates of, say, the kings of Assyria, "which are, comparatively speaking, of yesterday, and we can simply tell that one succeeded another in a definite order, how can we reasonably expect to fix the date of any one period of the geological past? . . . the geological 'when' merely implies before and after, while in history the idea not only of sequence, but of the lapse of how long before and how long after, can be mastered. The attempt to fathom the geological past with our short historical sounding line has up to the present time resulted merely in estimates, varying according to the assumed basis in each by thousands of centuries, that have been about as valuable in geological theory as Archbishop Usher's chronology has been found in Biblical criticism"

Sunday Lectures

A LECTURE delivered by Prof. T. H. Huxley in St. George's Hall, London, on Sunday, March 13, entitled "The Forefathers of the English People", is printed in full. Commenting on the occasion, a "note" reads:

"It is surely a sign of the times that we should be able to lay before our readers a scientific lecture delivered on a Sunday before a great audience, composed chiefly of the middle classes. The history—the all too short history—of English Sunday lectures is very curious and, withal, instructive. Some years ago the movement was commenced by lectures in St Martin's Hall, which lectures, thanks to the activity displayed by 'The Lord's Day Observance Society', were brought to a close somewhat suddenly. They were afterwards revived (such is the perfection of our English law) with impunity, by the simple process of enrolling the lecturers and their friends as a religious body!" Eventually, two movements arose, the Sunday Lecture Society, and another, "emphatically the working men's movement, in which the exact programme which was at first threatened with prosecution is reproduced. Both these movements have been in operation, and have been the means of doing much good for some time past; and no attempt has been made to interfere with that 'Free Sunday' which is of a good deal more importance to the working men of this country than even a 'Free Breakfast-table'. Surely one of those quiet victories by which each step in the march of real progress has been made good in English history has been won".

Hereditary Genius

ALFRED RUSSEL WALLACE reviews at length Galton's "Hereditary Genius, an Inquiry into its Laws and Consequences". "In this book Mr. Galton proposes to show that a man's natural abilities are derived by inheritance, under exactly the same limitations as are the form and physical features of the whole organic world. Many who read it without the care and attention it requires and deserves, will admit that it is ingenious, but declare that the question is incapable of proof. Such a verdict will, however, by no means do justice to Mr. Galton's argument . . . his book will take rank as an important and valuable addition to the science of human nature".

A NATIONAL History Society has just been formed at Winchester College. There is every reason to expect that the society will prove a lasting benefit to the college.

WE are glad to see that meetings are being held in support of M. W. S. Allen's motion in the House of Commons to open museums on week-day evenings. We know of no argument against the experiment, and we believe the experiment would be an entirely successful one.

THE Vicar of Cushendun, County Antrim, communicates the following to *Science Gossip*: "The following incident was told me the other day by a resident, who vouches for the truth of it, and which happened close to his residence in Cushendun, County Antrim. A rat, nearly white with age, and blind, was frequently seen led to the water by a young rat by means of a straw, of which the old rat held one end and the young rat the other".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned.

ASSISTANT EXECUTIVE ENGINEERS in the Punjab Service of Engineers, Class I—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 1/4A) (March 23)

ASSISTANT OFFICERS (CIVIL ENGINEERS) in the Indian Railway Service of Engineers—The High Commissioner for India, General Department, India House, Aldwych, W C 2 (quoting Appointment 275/1A) (March 23)

DIRECTOR OF EDUCATION—The Director of Education, Education Department, Newarke Street, Leicester (March 27).

SUPERINTENDENT OF TECHNICAL CLASSES under the Government of Trinidad—The Secretary (IPR/CA), Board of Education, Kingsway, W C 2 (March 27)

SECOND ASSISTANT BACTERIOLOGIST AND PATHOLOGIST—The Clerk to the County Council, County Buildings, Stafford (March 28).

VICE-PRINCIPAL—The Principal, Bergman Osterberg Physical Training College, Dartford (March 29).

DIRECTOR OF RESEARCH—The Secretary, Research Association of British Rubber Manufacturers, 105–107 Lansdowne Road, Croydon (April 6)

EDUCATION OFFICER—The Clerk to the London County Council, The County Hall, Westminster Bridge, S E.1 (April 15).

ASSISTANT LECTURER IN GEOGRAPHY—The Registrar, The University, Manchester 13 (May 1).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Health. Emergency Medical Services, Memorandum No. 5: Oxygen Administration—Indications, Methods and Types of Apparatus. Pp. 7. (London: H.M. Stationery Office.) 2*d*. net. [262

The Case for the Immediate Introduction of a System of Family Allowances and Alternative Proposals for such a System. By Eleanor F. Rathbone. Pp. 16. (London: Family Endowment Society.) 6*d*. [262

Other Countries

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1938. By E. Rodrigo. Pp. 98. (Colombo: Government Record Office.) 1 rupee. [262

NATURE

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Vol. 145 SATURDAY, MARCH 23, 1940 No. 3673

LIBRARY

METHODS AND AIMS IN AMERICAN ARCHÆOLOGY

ALTHOUGH archæologists in the United States welcomed the financial assistance afforded field research and excavation by the measures taken by the Federal and State Government authorities for the relief of unemployment, their satisfaction was tempered by some misgiving It is true that it now became possible to open up sites long marked as desirable for investigation, but of which the examination had to be postponed while the funds available were devoted to purposes of more insistent urgency in their bearing upon major archæological problems At the same time, it was recalled to how great an extent the antiquities of the remarkable and unique indigenous civilization of the Americas had suffered from amateur and untrained trophy hunting. Further, public works were being inaugurated or accelerated which would add to the destruction on a vastly extended scale. The construction of a great dam in the Tennessee Valley during the War of 1914–18, for example, had inundated twenty-three square miles of country, and to this the projected scheme of the Tennessee Valley Authority would add a further 100 square miles, both tracts taken from a territory thickly studded with relics of Indian occupation, of which so considerable a proportion would now be lost for ever to archæological study. It was evident that there was an urgent call both for trained and skilled supervisors of excavations and public works, and for a scheme of conservation to preserve as much as was possible of the evidence of antiquity for study by posterity.

As an outcome of this apprehension, the matter was taken in hand by the National Research Council. In April 1939, the Division of Anthropology and Psychology of that body appointed a committee to study the needs of American archæology. This committee was composed of some of the most active among practising archæologists of the United States; among them were Dr. A. D Strong, who acts as chairman, Dr. Clark Wissler, Dr A V Kidder, Prof. Fay Cooper Cole, and Dr. W S. Webb The Committee has already published a report of a preliminary nature, of which an analysis by Dr. Carl E. Gutha, chairman of the Division of Social Sciences of the National Research Council, appeared in *Science* of December 8, 1939

It has been pointed out recently that in the study of the indigenous civilization of the Americas, but more especially of the northern half of the continent, the distinction in method and outlook between archæological studies and ethnography and ethnology is by no means so strongly marked as it is, as a rule, in the study of Old World civilizations. On one hand, archæological methods and arguments more and more have to be applied to the reconstruction of an Indian cultural complex, while on the other hand interpretation of archæological data may be illumined by reference to the evidence of ethnography recording traditional Indian custom and belief, a source of which perhaps the fullest use has not always been made. Why Americanist studies should be peculiarly favoured in this way must be obvious. For one thing, American civilization, when once the tide of early immigrant peoples ceased to flow, remained virtually free from serious outside cultural and racial influence for some centuries—or at least so those of us would believe who are not diffusionists—until the impact of European civilization, at first of the Norsemen, though this is virtually negligible, and

afterwards of other European peoples in the late fifteenth and sixteenth centuries. Further, and partly as a consequence of this prolonged isolation, American civilization shows a remarkable continuity of development, as well as a stability of condition, which has affected not merely the indigenous population but also the development of white civilization, a fact which writers on American civilization in its broader aspect have perhaps sometimes failed adequately to stress

If we ignore the industrial zone and areas of mineral exploitation, American civilization is still based on agriculture and animal exploitation, though it is true that the place of the hunter and the bison is taken by the cowboy and vast flocks and herds of domesticated animals. Even though corn now grows in the plains where the bison once was hunted, this implies no break in the cycle of cultural development, for even as the agriculturist in the Old World has displaced the hunter, so in America the farmer has edged the herdsman off the lands which generations of wild cattle had fertilized for his crops of corn The readiness of the early settlers and pioneers to adopt elements from indigenous culture, many of which survive to this day, bears testimony to the influence of the continental environment in moulding the technique of living from day to day

It is evident that some such conception of the function of archæology in Americanist studies, as illustrative of a continuous development, was present in the collective mind of the Committee in deciding on the scope and in framing the terms of the preliminary report The sphere of interest of that report, it was felt, was best limited to "an analysis of the principles which govern the methods and procedures of American archæological research" and could most usefully indicate its basic needs

As herein formulated, the aim of American archæology is said to be "to make the past live again, to preserve for posterity the story of the rise and spread of early cultures on the American continent and their influence on white settlement" From such studies, it is pointed out, much may be learned, not only in the field of human history, but also of such significant subjects as long-continued land utilization, cycles of climatic change and the history of important agricultural crops. It is interesting to note the implicit recognition of the fact that, given continuity of environmental and climatic conditions, an academic problem in archæology may have a practical bearing on the affairs of even such a progressive modern community as is found in contemporary American civilization.

The Committee recognizes fully that much excellent work has already been done and experience gained, as well as much valuable information gathered, through the assistance granted by Federal and State schemes for the relief of unemployment or in rescuing prehistoric records in districts about to be flooded. Yet in view of the fact that these relief projects are to be continued, and others are contemplated, it has been thought urgent that a statement should be issued at the earliest possible moment, giving the minimum requirements with which future work, whether public or private, should comply, in order to attain a standard of scientific accuracy satisfactory for the needs of archæological studies. In view of the stress laid upon general principles of archæological research and conservation, this document is of more than merely local interest.

In framing its statement of these requirements, the aim of the Committee has been to eliminate anything and everything in the nature of haphazard excavation With this in view, it has covered every stage of the research in broad outline from its initiation, concerning which it is laid down that "a definite need should be shown for the solution of a well-defined archæological problem or for the conservation of prehistoric material placed in jeopardy by public works or other agencies, whether natural or human", down to final publication of a report which, it is insisted, should be as speedy as possible after the completion of the investigation. In regard to this latter point, however, it is emphasized that archæological investigation and 'hustle' have no affinities.

The Committee has laid down in some detail the organization for which a scientific institution or learned society must be prepared to provide when undertaking the responsibility for a research project under any one of the schemes fathered by Government authority. That responsibility cannot be regarded as ceasing with the provision of skilled archæological supervision. To this must be added the field staff, with academic training and field experience, competent to keep proper records in addition to carrying out the practical work of surveying, excavating or conducting the technical work of the laboratory, with, be it said, the complete equipment of technical apparatus, cameras, surveying instruments and the like, which each department of this work demands. A somewhat higher degree of specialization in function is

demanded than is commonly practised; but the useful principle is laid down that whereas the methods of the field and the laboratory differ, there should be one director who is supreme over both departments

It is unnecessary to follow the Committee through all its detail of instructions. It will suffice to say that these are such as to satisfy an exacting standard Two matters, however, may be specially mentioned. In view of the amount of detailed record required, the need of adequate clerical assistance to relieve the director and archæological staff is emphasized, and secondly, it is pointed out that in view of the need for national conservation—a basic need—not only should each site opened be excavated with the greatest care, the material carefully studied and the results fully published, but also certain sites in every area should be carefully preserved for research in the future as new techniques are developed; this last is a requirement of much wisdom, which Sir Flinders Petrie impressed upon excavators of archæological sites in the Old World many years ago

The Committee ends its admonitions to the prosecution of such "forward looking activities" by pointing out their application, not only to academic bodies, but also to the National Park service, State historical societies, and municipalities, to which such studies should appeal as advancing the growth of national consciousness At the same time, the soundest piece of advice given is that reserved for the last, namely, that if the foregoing minimum requirements cannot be fully met by any Federal, State, or local institution, it should not undertake archæological research at all.

Notwithstanding the different circumstances of the Old World and the New, the line of approach to their problem adopted by the archæologists of the United States is not without its lesson for their fellow-workers elsewhere. In method and technique, except as regards completeness of organization, it may be that there is little to be learned. In regard to the future of archæological studies, however, while no one can foretell what post-War conditions may bring forth, it may be assumed that greater economy of effort and a greater measure of co-operation than has prevailed hitherto will be demanded. The direction of research to crucial problems, which would seem a necessary corollary, demands a survey, no less comprehensive and no less authoritative than that now in progress in America, for which the temporary check in field work affords an opportunity.

THE RELATION OF SCIENCE TO DEMOCRACY

(1) Democracy
Today and Tomorrow. By Eduard Beneš. Pp. x+244. (London: Macmillan and Co., Ltd, 1939.) 8*s*. 6*d*. net.

(2) For Democracy
Edited by the "People and Freedom" Group. Pp. x+ 237. (London: Burns, Oates and Washbourne, Ltd., 1939.) 8*s*. 6*d*. net.

(3) Spiritual Values and World Affairs
By Sir Alfred Zimmern. Pp. vi+ 178. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 7*s*. 6*d*. net.

THE growing concern of scientific workers with the social consequences of the application of scientific knowledge, and the deepening interest in the scientific investigation of social problems, of which the formation of the new Division for the Social and International Relations of Science of the British Association is only one illustration, have been prompted at least in part by the realization that the nature of the society in which they work has a powerful influence on the direction, and even the nature, of scientific work. This, and the increasing extent to which scientific and technical factors are involved in the solution of major administrative problems in national and international affairs, have induced many scientific workers to overcome their habitual dislike or distrust of political matters sufficiently to take a much closer interest in forces which may have such a powerful influence on their own work.

While, however, the events of recent years have made the maintenance of professional integrity and independence of increasing importance if the scientific worker is to continue his disinterested and dispassionate search for truth, and at the same time have indicated the dangers attendant on his allowing himself to be drawn into party politics or committing himself to the support of policies or statements in fields of which he has no

special knowledge, the great body of scientific workers has come to realize that the very continuance of scientific work and investigation itself is linked up with the continuance of that form of political order or government which we know broadly as 'democracy'. Only in the remaining democratic countries is that freedom of thought and investigation and teaching which is the very life-blood of science, safe from violation at the behest of political dogma

The recognition of this relation of science to freedom of thought and speech under democratic institutions led to a remarkable manifesto issued last year on behalf of American Men of Science (see NATURE, 143, 309, 1939) which can be placed alongside an earlier resolution of the American Association for the Advancement of Science Defence of that freedom has drawn Great Britain and France into war. Even in a democracy, however, war-time exigencies may impose limitations which demand increasing vigilance if the cause of truth and freedom is to be served, and it is well that scientific workers should consider closely the relations of science to democracy, and the exact significance, advantages and dangers of political systems.

(1) Dr. Beneš's book is based on three lectures on the problems of democracy, which were delivered at the University of Chicago in March, April and May 1939. He gives us a searching analysis of the causes underlying the decline of democracy in the Europe of 1918–38, as well as of the League of Nations, which he insists is a symptom and expression of European and world democracy, and can exist and function morally only in a democratic world. The League, he urges, is the expression of the philosophy and morality of democracy—respect for the individual as the highest value in social life—as an end and not as a means. His analysis of the causes underlying the failure of the League, which he attributes mainly to the decline of the European democracies, leads Dr. Beneš to conclude that real and effective activity of the League of Nations as it is constituted to-day, or of a League based on similar principles, will only be possible when Europe and the world turn to democracy.

Dr. Beneš does not, of course, ignore other factors in the decline of the League, and his discussion of the conflict between theory and practice, of the difficulties with economic and military sanctions, and of the reserved or even hostile attitude of individual States, even when members of the League, towards its principles and policy, are highly pertinent to discussions on federation and the world order to be established after the present war. For Dr. Beneš, however, the nature of the political system is fundamental. He considers that only democracy is capable of solving justly and rightly the eternal problem of liberty and discipline in human society. Human nature and human society involve man in a continual struggle for a reasonable, well-balanced relation between collectivity and individual freedom, and for this he can contend only in a political democracy.

For reasons such as these, Dr. Beneš visualizes no compromise, or at least no stability, in a system which admits such fundamentally opposed political systems as the totalitarian State and the democracies In his view, however, the former are temporary regimes in the slow process of adaptation to new conditions, and before the outbreak of war the authoritarian regimes were approaching breaking point Only with the disappearance of democracy or dictatorships can peace and collaboration of nations in Europe be re-established.

Dr Beneš's analysis of politics and leadership in a democracy gives us deep insight into his own conception of democracy. Politics in a democracy, he urges, is both a real science and a special kind of art, it is also something of a philosophy. Political science, the practical application of sociology, is a main part of sociology. It involves the study of the actual state of man in his relation to society and to his whole environment. It inquires what is regular, planned and constant in society. As a science, politics must look at the world objectively, must search for objective reality and analyse society thoroughly and widely. All social sciences, psychology and to some extent biology must thus be the concern of the politician, who should understand scientific method and be capable of analytical reasoning.

Politics, however, is not only a science but also an art, and as such has its creative aspects. Without the power of imagination, combination and synthesis no politician can create his new social reality, while as a man of science he must be a psychologist in both theory and practice. Finally, the politician must be a philosopher inquiring in which direction and by what means the adoption and changing of social reality must be accomplished. He must be able, moreover, to recognize what is and what is not possible politically.

With these ideals and requirements in the political leaders of democracy and with his insistence on moral as well as intellectual personality, it is not surprising that Dr. Beneš stresses the importance of training and selection for leadership. If a great politician and real statesman in democracy must possess a mind harmonizing these mental faculties and combine the analytical rational element, the artistic, imaginative and synthetic element, with philosophic and moral

power, leadership must be a question of good education and careful selection. To engage in politics in modern life and in a democracy without very hard intellectual work, great erudition and high comprehension of all divisions of science is impossible.

Scientific workers will welcome this emphasis on the importance of scientific training for those entering on political and administrative careers, but they should note also that Dr. Beneš is careful to point out that leadership demands something more than a man of analytical or reasoning capacity or scientific knowledge. Beyond intellectual ability, leadership involves decision and courage. Scientific learning or culture must be combined with keen intuition, and the capacity for rapid decision and action and for physical and moral courage

On such leadership Dr Beneš rests his hopes of dealing with the practical problems which democratic States must face in the immediate future the reinforcement and consolidation of the executive power, and the development of new functions of the State ; the establishment of better harmony and equilibrium between the judicial, legislative and executive organs in democratic rule ; the redress of the weakness and deficiencies of the party and voting system, and the problems of nationalism and social reform. Such leadership alone will be equal to the establishment of a real and effective collective security and of a League of Nations which will afford the opportunity for such developments.

(2) "For Democracy" is a collective work. Its scope is wider in some ways than that of Dr Beneš's book, for the first part of the book traces the development of democracy from the experience of Greece and Rome. If it has less to say about the League of Nations, like Dr. Beneš's book it includes an excellent short account of the modern totalitarian State and its dangers to freedom Dr Luigi Sturzo, the former leader of the Italian Popular Party, contributes a notable essay on democracy, authority and liberty, and this, with his concluding essay. on the future of democracy, is what scientific workers may find of most immediate appeal in the volume, though the significance of the deep-seated sense of unity pervading these writers—three French, two Italian, one German and one Spanish—revealed in these studies of democratic ideas and institutions seen through Catholic democratic eyes as a factor in movements towards the development of a United States of Europe should not be overlooked.

To Dr. Sturzo the spirit of democracy is freedom actuated in social life as correlative to authority, an authority in which the whole people shares, according to the capacities and position of each, in co-operation for the common good. It is in such a system that intellectual activities such as science can find their natural freedom of development, for that freedom which lies at the basis of democracy is also the life-blood of science. The main task in the defence of democracy to-day is the defence of freedom, and the defence of freedom is at the same time the defence of authority and of the social order.

In this defence Dr. Sturzo lays the main emphasis on education, involving not merely culture and training in the exercise or practice of political life but also in moral values. Intellectual or technical education alone offers no safeguards against the fanaticisms of the age, such as anti-Semitism In this insistence on permanent moral values worthy of men and in harmony with the principles of Christianity, the book adds one more to the many which, like Middleton Murry's "The Defence of Democracy" or "The Price of Leadership", are stressing the necessity for a Christian basis of society if a new world order safeguarding the noblest traditions and ideals in man's inheritance, which democracy alone has preserved in the past, is to emerge out of the present chaos.

(3) Sir Alfred Zimmern's study is of an entirely different type. It makes its appeal to the scientific worker pre-eminently through its contribution to lucid thinking and its indication of the pitfalls and dangers which beset the study of international affairs. Sir Alfred, too, insists on the importance of moral and spiritual values He appeals strongly for close study of international affairs by the ordinary citizen, but he stresses also the imperative necessity of clear and accurate thought if we are to realize a new world order which will adequately safeguard our heritage.

It would indeed be difficult to find a finer stimulus to such thinking than this compact little volume of cautionary wisdom. How many fatal mistakes might have been avoided had there been more scientific thought about international affairs in place of the disposition to regard the League as a short cut to Utopia, and to forget that it only marked the beginning of a new phase of world order, or that a League policy involved the participation and interests of many, not of one nation. What Sir Alfred says of the intellectual confusion due to the intrusion of religion into the discussion of problems on which religion by itself could offer no safe guidance has a bearing on many similar matters involved in the relation of science and society, the significance of which the scientific worker who reads this book can scarcely fail to appreciate.

There are indeed sections in this book in which Sir Alfred seems to be expanding the scientific method itself, and his chapters on the War of

1914–18 and its aftermath, on peace, on our English burden and on the Colonial problem could scarcely be bettered as an aid to lucid thinking about the problems of world order which will confront us after the present war. Apart from this, Sir Alfred insists that there are three necessary stages in the process leading from the prevailing anarchy to some form of world organization. Peace—the cessation of actual fighting—is only the first of these. The second is order, or what is sometimes called the stage of the hue and cry—the stage at which violence is prevented or punished by the public spirit of the citizen body, the leading democratic peoples The third stage is that of law, where the habit of co-operation developed through common action in repressing violence has hardened into social rules for the conduct of what has then become a common social life.

The phrase "law and order" has probably been responsible, as Sir Alfred points out, for much false thinking in this sphere, and to convert it into real "order and law" should conduce to the lucidity essential in our thinking about a new world order The scientific worker will, however, find neither here nor elsewhere in these three volumes the 'blue prints' of the world order which he in common with other lovers of truth and freedom desires He will, however, find much that is stimulating, much that is corrective of confusion and much that should encourage him to take his own part in the travail out of which the order will be born Nor should he be ungrateful for the evidence the volumes afford of the widely diverse fields in which men are turning their thoughts to such constructive purposes, and of the grounds for confidence in the power of democracy to prevail over the forces now threatening all that is noblest in man's moral, spiritual and intellectual heritage

R BRIGHTMAN

HYDROCARBONS

Physical Constants of Hydrocarbons

Vol 1: Paraffins, Olefins, Acetylenes, and other Aliphatic Hydrocarbons. By Gustav Egloff. (American Chemical Society Monograph Series, No. 78.) Pp. 412. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 45s. net

IT has become almost a commonplace to refer to the tremendous advances which have taken place in the field of hydrocarbon research A very large and prosperous industry has come into being almost entirely as the result of scientific research, and its leaders have realized that money must be devoted on the grand scale to such research if it is to continue to expand.

The relatively simple hydrocarbon with only two elements—carbon and hydrogen—and a straight-chain formula was almost despised not so many years ago by chemists busy unravelling the complex structures of the anthocyanins and the alkaloids, the purins and the proteins. To-day they are in the forefront of interest in many laboratories, largely as the result of the stimulus given to the exploration of the vast number of different hydrocarbons present in crude petroleum by industry's demand for new products.

For industrial purposes, fractions of the original crude of wide range of boiling point at first sufficed. Modern practice demands fractions of much smaller range, and the individual hydrocarbons are beginning to have possible technical significance. An exhaustive separation of the individual hydrocarbons is being effected as the result of co-operative research at the Bureau of Standards in Washington, and compounds which have hitherto received no attention are the object of experimentation.

The modern high-compression engine demands a special fuel with a high octane number, as the oil men term it. Straight-run or even cracked spirit alone does not suffice, and there is an indication that the fuel of the future will be a petrol re-formed from the hydrocarbons after cracking and catalysed synthesis. More and more the hydrocarbons are coming to be regarded as the primary raw materials for industrial organic syntheses

The hydrocarbons are largely identified by four physical constants: melting point, boiling point, specific gravity and index of refraction. For a long time there has been an urgent need for a critical digest of all data pertaining to these. Such a systematic study has been going on in the laboratories of the Universal Oil Products Company in Chicago, and it is to be published in four volumes, of which the first is now before us. The first three volumes will contain the physical constants, whilst volume 4 will deal with their inter-relationships as well as correlating physical properties with structure.

The first part covers the open straight- or branched-chain hydrocarbons, namely paraffins, olefins, acetylenes and other aliphatics: they are

actually grouped into ten sections. The procedure adopted is described in a short introduction and the rest of the book consists entirely of tables. Everything is very clearly printed and most easy of reference.

Dr. Egloff has long been a pioneer in research in the oil industry; indeed I think he was one of the very first to envisage the future importance of hydrocarbons as opposed to mere oil His knowledge of the subject is profound, and though it has been always freely made available to those who sought it privately, the fact that he has now consented to turn author is of inestimable service to every industry in which hydrocarbon chemistry plays a part. His previous work on the "Reactions of Pure Hydrocarbons" has already become indispensable to us as individuals; his physical constants will be consulted as often in oil laboratories as is the "Oxford Dictionary" by writers.

Such a book must necessarily be costly, though the price is of no importance in industrial laboratories in relation to the utility of the book, which is of the type which does not grow out of date and will remain a standard reference book for many years to come It is a monument to the name of Egloff. E F ARMSTRONG.

ORDNANCE AND GUNNERY

Elements of Ordnance

A Textbook for Use of Cadets of the United States Military Academy. Prepared under the direction of Lieut-Colonel Thomas J. Hayes. (A revision of the "Textbook of Ordnance and Gunnery", by Colonel Earl McFarland.) Pp. x + 715. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1938) 32*s* 6*d*. net.

THIS is by no means a new book. In its present form it appeared in 1938. But like most service text-books it is a compilation which represents a more modern version of an earlier work It is none the worse for that. On the contrary, it is well written, well and lavishly illustrated, and it is excellently produced. The index, as befits a work of reference of this extent, is full and satisfactory.

The ground covered is very wide indeed and may be briefly indicated. Three chapters on propellants, explosives and metals deal with the relative parts of physical chemistry and metallurgy. Six chapters of a more or less theoretical kind deal with internal and external ballistics, including probability, gun construction and recoil, and bombing from aeroplanes. This last indicates that the range of subjects treated is even wider than the limits which apply to the gunner. The remaining chapters, ten in number, are essentially descriptive. They cover the design of breech mechanisms, types of artillery, sights and fire control instruments, including the equipment used in conjunction with anti-aircraft artillery, gun ammunition and fuses, small arms and the corresponding ammunition, bombs and grenades; a short chapter on the properties of light armour leads to one on mechanical vehicles. These are, in the main, tanks. Carriages are described in connexion with the corresponding types of artillery, coast defence or mobile, but the subject of tractors seems to have been dismissed more summarily. Tables at the end of the book provide useful data from physical chemistry.

The mere recital of the contents of this book should serve to show how vast is the field which lies before the modern artillerist. For all its seven hundred pages this is only an introduction to the subject, and a very good one. It is intended as a text-book for the First Class in the West Point Military Academy As such it is supplemented by lectures and shop and laboratory practice. At once it is suggested that the U S cadet who is destined to find his career as a gunner leaves the Military Academy with a preparation far in advance of his opposite number in Great Britain. Whether it has been sufficiently realized that modern developments have made the subject of artillery a highly scientific branch of activity, demanding the service of the most gifted and the most highly trained brains, is a question which deserves the most serious consideration. It is not, of course, to be assumed that every young American gunner absorbs all the fare that is set before him.

For the general reader and even for some whose concern with the subject is more specialized, the most interesting and valuable chapters are probably the descriptive Naturally, American equipment, methods of manufacture and designs are treated exclusively. But under the stress of modern rivalry the types of armament employed in different countries tend in the main to close similarity. It is in points of detail that the chief differences will be found. Against a single national point of view, moreover, a compensating advantage is to be set. There is no trace here of that atmosphere of secrecy, generally futile, on which most military authorities insist. It would, of course, be unsafe to infer that the whole of American practice is revealed without any reservation whatever. But

there is a refreshing absence of that concealment which serves no useful purpose and only tends to make legitimate instruction difficult.

The chapters which deal with the mathematical theory are less satisfactory for the simple reason that they are of necessity too short to furnish more than an introduction to this aspect of the subject They have no other noticeable fault and within their prescribed limits they are highly instructive. Thus while the account of external ballistics is so brief that the serious student will need to supplement it by consulting some at least of the standard books and original memoirs, of which a good list is appended to the chapter, the subject of yaw is treated in some detail The effect of probability on the fall of rounds is discussed in a separate chapter. It seems curious that nowhere is the normal law of frequency more implicitly accepted than by gunners, who at the same time are very ready to reject rounds which appear to be anomalous The inclusion of the subject of bombing from the air serves to remind the reader of the mutual relations which obtain in different countries between the army and the air force, and of the fact that the complete separation of the two forms of national defence is apt to entail some loss of a common understanding of technical problems.

Of internal ballistics it is said that "Interior ballistics is not an exact science". It is a complex problem certainly, yet the elements for its solution lie in physical chemistry and in mechanical conditions which should be capable of definition An exact answer may not always be beyond the range of possibility But there are two obstacles in the way. In the case of a problem which is at the same time highly complicated and of practical importance, the temptation is strong to avoid the scientific investigation of all the underlying factors and to reach the end in view, which is to predict the performance of a newly designed gun, in more summary fashion. Here, since all arsenals possess the records obtained by firing guns of many types, the empirical method of interpolation, or extrapolation, is commonly employed. But this does not mean that a more scientific treatment, in which considerable progress has already been made, can never be brought to practical perfection

The chapter on recoil is one of the best in the book, but that on gun construction is far less satisfactory. The method of wire-winding is naturally dismissed shortly, for it has been superseded, though effective guns of this type remain in the U.S service The built-up gun may also be doomed to disappear. It is disappointing that the theory of auto-frettage has not been discussed at greater length, though this process of manufacture is fairly described. Both the 3-in. and the 105-mm. A.A. guns of the American service consist of an auto-fretted tube with loose-liner. But it is interesting to learn that the same service has adopted a 155-mm howitzer which is an auto-fretted tube without liner; it is stated that this monobloc construction greatly reduces the cost and is easily replaced in the field. What steel is used in this weapon is not mentioned, and though the properties of various modern alloy steels are described no figures seem to have been given for the high elastic limits which can now be reached with increasing ease and certainty. It does not seem impossible that the process of auto-frettage with its obscure theory will go the way of other methods now abandoned, and that the gun of the future will be a simple monobloc, with or without a loose liner.

H. C. PLUMMER.

USELESS MATHEMATICS

Mathematical Recreations and Essays
By W W Rouse Ball Eleventh edition, revised by H. S M Coxeter. Pp xvi + 418. (London: Macmillan and Co., Ltd., 1939) 10*s* 6*d* net

EVERY former reader of Rouse Ball's classic will rejoice that a new edition has been brought out. They will miss some old acquaintances, particularly the chapter on string figures, but they will find a good deal of new material, notably a chapter by Dr. Coxeter on polyhedra, and one by Mr. Sinkov on cryptography.

The book is remarkable in several respects. In the first place, although it demands no mathematical knowledge beyond elementary algebra and geometry, it brings its reader to the edge of mathematical knowledge at many points. Some of the unsolved problems treated are fundamental, such as the four-colour problem, that scandal of topology. Others, such as Kirkman's problem of the schoolgirls, will probably yield to combinatorial analysis without any revolutionary discoveries.

In the second place, almost all the mathematics is inapplicable to practice. The Admiralty staff are not likely to be presented with the problem of the three jealous husbands and the ferry-boat (p 116) when arranging convoys, nor will the theory of mazes help the German General Staff to penetrate the Maginot Line. But parts of the chapter on polyhedra have an application to crystallography, and the theory of Latin squares has been extensively developed in connexion with

agricultural tests. The most recent work on it is indeed published, paradoxically enough, in the *Annals of Eugenics*.

"Mathematical Recreations" constitutes an addendum to every mathematical library. I can imagine no better book for a schoolboy or girl who is taking mathematics seriously The reader will find himself introduced to advanced topics such as topology, group theory, and prime number distribution theory, without any intellectual strain, and will learn a surprising amount of mathematics without knowing it. The more advanced reader will find some novelties in every chapter Above all, one need not read the book systematically On the contrary, it is an excellent bedside book into which one can dip at random.

The War may discourage mathematical reading It need not. I remember that among a row of wounded officers on the deck of a barge in Mesopotamia in 1917, the occupant of the next stretcher to my own was reading Lamb's "Infinitesimal Calculus", whilst I was reading Kelland and Tait's "Introduction to Quaternions". But systematic study is certainly difficult, and perhaps "Mathematical Recreations" would have been more suitable.

I hope to see many more editions I may be accused of attempting to gild the lily, but here are two suggestions for the next Since the theory of Mersenne's and Fermat's numbers is part of the theory of recurring 'decimals' in the scale of 2, I should like to see an excursus on recurring decimals in the scale of 10, pointing out, for example, why every recurring decimal with a period of 10 must have 9091 or a multiple in its denominator, and since such formulæ as $\frac{1}{4}\pi = 4 \tan^{-1} 1/5 - \tan^{-1} \iota/239$ are equivalent to factorizations of $n + n\iota$, readers might be introduced to complex arithmetics on p. 348

However, Dr. Coxeter knows his job better than I do, and has shown himself a worthy successor of Dr. Rouse Ball This is the eleventh edition May there never be a last edition.

J B S HALDANE

GENERAL ASTRONOMY

(1) Astronomy

By William T. Skilling and Robert S Richardson Pp. xi+579. (London: Chapman and Hall, Ltd, 1939). 15s net

(2) Exploration du ciel

Par Pierre Rousseau. (Le roman de la science) Pp. 256 (Paris · Hachette et Cie, 1939.) 20 francs

(1) THE progress of astronomy, as regards both the methods and results of research, is in these days so rapid that there is always room for a new and up-to-date text-book on the subject Messrs. Skilling and Richardson's book is the most recent of several that have appeared in the past few years; and it covers the whole field of descriptive astronomy in a simple style, suitable for the general reader.

The insertion of examination questions at the end of each chapter suggests that the work was intended to afford a complete elementary course for students. Unfortunately its usefulness for this purpose is much impaired by a certain lack of the balance which should characterize a really satisfactory text-book. Thus, while the subject of solar physics is treated in considerable detail (one of the authors being a specialist in this line of research), the planetary system is dealt with in a rather perfunctory way. The minor planets, for example, are dismissed in little more than a single page, while no mention is made of the variable rotation periods of Jupiter and Saturn, or of the transparency of the latter's ring system. On the other hand, the book certainly contains much up-to-date matter of great interest and value to the student It is well supplied with illustrations, though some of the diagrams are open to criticism. The text appears, apart from a few minor errors and misprints, to be substantially accurate, but the so-called "glossary" at the end of the book is so abbreviated as to be practically useless.

A glance through the names of astronomers quoted in the index will reveal a certain parochialism which is rather common in American scientific books But it is perhaps a pardonable weakness, and one from which no nation seems to be altogether immune.

(2) M. Rousseau's book consists of a series of popular essays on various aspects of modern astronomy The author's avowed aim has been to humanize the subject and to emphasize the romantic side of research. To this end he devotes considerable space to the description of the more important astronomical instruments, and of the way in which they are actually used for various purposes. This seems to us a particularly attractive way of dealing with the subject, and M. Rousseau's obvious enthusiasm can scarcely fail to communicate itself to his readers, whether they be possessed of previous astronomical knowledge or not. The book seems worthy of something rather better than its present flimsy cover, and it is a pity that the quality of the paper has ruled out the use of half-tone illustrations.

W. H. STEAVENSON.

PHYSICS IN THE GLASS INDUSTRY

By PROF. W. E. S. TURNER, F.R.S.
UNIVERSITY OF SHEFFIELD

IT is in keeping with the transparent nature of the substance that the first physical properties of glass to receive conscious study in comparatively modern times should be the optical properties. The problem of dispersion in the simple telescope lens found a partial solution in the achromatic lens combination of John Dollond in 1758, and the subsequent development of lens systems, in which the correction of chromatic aberration is still more complete, has involved the utilization of glasses of different and precisely known refractive indexes and dispersions The work of Guinand, of Faraday, of Harcourt and of Schott was in all cases concerned with the production of better glasses of constant optical properties, or of new glasses permitting a wider range of optical properties for use in combinations.

With the work of Schott, however, there was opened up the possibility of exploiting some of the new glasses experimented with, for purposes other than components of optical instruments. Thermometer glasses of low after-contraction were one development. The accumulation of general physical data about glass had set in at Jena, so that, between about 1883 and 1895, many data were compiled about density, thermal expansion, thermal conductivity, tensile, compression and other aspects of mechanical strength , and although in recent times some of these data have had to be drastically revised, they led to the manufacture of a variety of new glasses for heat resistant and other purposes, and pointed to the usefulness of certain compound glasses.

For the next twenty years, the impact of physics on the industry was less exciting and dramatic, but some of the results at least contained the seeds of later important developments Then began an altogether new period in which striking individual results of physical studies led to new types such as Pyrex and other low thermal expansion glasses ; R. W. Wood's glass ; the Corex glasses, etc , side by side with the development of revolutionary processes in which highly productive automatic machinery began rapidly to displace the hand worker. The manufacture of glass bottles and containers in thousands of types , of sheet and plate glass ; of electric light bulbs, of glass tubing and rod and of some types of domestic glassware has within the past twenty to twenty-five years been transferred almost entirely to highly productive automatic machines, the efficient functioning of which was, in a number of cases, achieved only after many years of development.

It is in these fields of manufacture that the bulk of the capital of the industry is locked up. That represented by optical and scientific glassware of all types is relatively insignificant. The development of several of these automatic machines was in the early years in the hands of the clever mechanic, with no background of systematic knowledge of physics and chemistry, or even of the fundamental principles of engineering It has been the service of the physicist to work out processes of control so as to maintain constant conditions under which the machine can operate favourably. As an illustration, it may be mentioned that with one automatic machine, the temperature of the molten glass (at 1140–1160° C., according to size of article to be made) in the bath from which the machine takes its own supply many times per minute, must be kept constant to $\pm$ 5° C. , and high-temperature pyrometry, glass-level control in furnaces holding huge quantities of the molten material, and various other problems have had to be worked out suitable for each set of conditions of operation At every stage of mass manufacture, speed and efficiency involve fundamental knowledge, and it is not surprising, therefore, that the widespread employment of physicists and chemists has really only begun with the introduction of mass manufacture.

Some conception of the part which the physicist plays both in the development of new types of glass and in the manufacturing control of others was clearly brought out during a discussion on February 15 on the subject of "Physics in the Glass Industry", held at the Royal Institution under the auspices of the London Branch of the Institute of Physics The contributors of papers to the symposium were Dr. Harry Moore on "Strains intentionally introduced during Glass Manufacture", Dr W. M. Hampton on "The Spectacle and Optical Glass Industry", Dr. Eric Seddon on "Physics in the Manufacture of Glass Bottles", Dr. B. P. Dudding on "Glass for Lamps and Electronic Devices", and Dr. J. H. Partridge on "Refractories used in the Glass Industry".

In the manufacture of spectacle and optical glasses, physical methods continue in the line of traditions of fifty or sixty years ago, though with some important developments. Both types of glasses must be controlled in respect of refractive

index so that repeat meltings are kept within ± 0.001 of the desired value for well-annealed samples. The Pulfrich refractometer is normally employed for this control and has an accuracy of one in the fourth place of decimals on refractive index and two in the fifth on dispersion; but master standard prisms of optical glasses of refractive indexes and dispersions measured to a few units in the sixth place of decimals are used to control the Pulfrich observations Modern optical glasses must also have a light absorption of not more than a fraction of 1 per cent per inch thickness, and the amount which occurs in the visible, ultraviolet and the infra-red has been the subject of close study and control, the main cause of absorption being the presence of very small amounts of iron oxide in solution. Spectacle glasses, on the other hand, may have colour dependent on the purpose for which they are intended, such as protective goggles for use by welders, and in all such cases the transmission in the three spectral regions must be determined as a routine control measurement.

The annealing of glass has received much detailed scientific and practical study during the past twenty years, in particular by Twyman and by Hampton in England, and by Adams and Williamson in the United States, in regard to general theory, and by English and Turner in regard to the relation of composition to the annealing temperature. The latter quantity is usually related to the viscosity, on which property of glass much work has been done in recent years At the highest temperatures used in melting a glass, the viscosity is usually reduced to not more than 100 poises, but with fall of temperature the increase of viscosity is such that at room temperature it should be of the order of 10^{18}. The viscosity corresponding to annealing temperature conditions lies between 10^{13} and 10^{16} poises, rapid removal of strains, that is, rapid annealing, being possible at the lower viscosity figure or higher temperature, slow annealing resulting at the higher viscosity.

The annealing temperature chosen depends on the character of the glass, on its size and thickness and the degree of strain permissible. In mass-produced glass the object is to anneal as speedily as possible, and the higher annealing temperature is accordingly chosen. In modern glass bottle annealing, as illustrated by Dr. Seddon, the glassware is annealed and cooled nearly to room temperature in less than two hours. In the case of the Fourcault sheet glass process, producing an article of simple shape and uniform thickness, it is a matter of only a few minutes before the flat sheet, drawn out of a bath of molten glass at approximately 1000°, emerges from the annealing shaft at a temperature cool enough to enable it to be carried safely in the open air. On the other hand, in the case of large slabs of optical glass, it is not unusual, as Dr. Hampton pointed out, for the annealing process to involve heating them slowly from room temperature up to the annealing temperature in five to six days, to maintain them for 24–70 hours at that temperature and then to cool them during the first 150° below the annealing temperature at a rate of perhaps only 10° per day. In the case of a large telescope disk, such as the famous 200 in disk, the cooling must be spread over several or many months.

Control of the distribution of strains in the flat-drawn sheet glass prepared either according to the original Fourcault process or its modification the Pittsburgh process, is important if excessive breakage is to be avoided In either method, there is some contrivance whereby the edges of the sheet, which may be more than 100 in. wide and up to ¼ in thick, are chilled and maintained rigid so soon as it is raised above the molten glass. This results in these edges being put into compression vertically as the temperature becomes uniform, whilst the centre develops tensile strain vertically, there being other tensions and compressions across and through the sheet. The tensile strains must not reach the breaking limit and must be so distributed as to leave the sheet substantially free from strain when, as is part of the normal operation, the edges are cut off. Dr. Moore described an elegant method now under trial of using Babinet compensators to maintain routine observations on the edges and centre of the sheet as it emerges from the drawing tower.

The physicist has also been set a problem by no means easy in the testing and control of 'toughened' glass produced by heating plate or sheet glass to a temperature some 50° C above the annealing point and chilling it rapidly by a blast of cold air from many small orifices, the result being to multiply several-fold the forces which it will withstand before fracture. The compressive forces thus introduced into the surfaces are such that the glass sheet can be bent or otherwise deformed considerably before these compression strains are removed and replaced by tensile strains under which glass almost invariably breaks, since the tensile strength is only one eighth to one tenth of that of the compression strength. Here control may be exercised by a combination of mechanical testing methods and of the tensile strains measured optically either on pieces cut from lightly 'toughened' plate or on 'toughened' thick plates of glass convenient for edgewise examination.

The Babinet compensator has also been a valuable tool in the study and control of permissible stresses in vacuum-tight glass-to-metal seals in electric lamps and valves; and of flashed opal

glasses, Dr. Dudding having some excellent coloured slides to show of strain patterns; whilst Dr. Hampton illustrated its use in the manufacture of bifocal lenses. In such a lens the major part consists of spectacle crown glass, into a depression of which a button of glass of higher refractive index is fused, and the whole then ground down to the required curvature. Satisfactory welding is found to require, for similarity of thermal expansion, coefficients of the two glasses to within $\pm 2 \times 10^{-7}$. Since 1920, many investigations of this property have shown that the thermal expansion–temperature curve deviates considerably from a straight line and at a transformation temperature the coefficient increases several-fold. The successful solution of the problem of obtaining two glasses, or a metallic wire and a glass, of thermal expansion curves closely agreeing with one another, is a testimony to the thoroughgoing nature of the study of this subject.

Researches on the electrical properties of glasses have had various practical applications, nowhere perhaps more vitally than in the electric lamp industry. By systematic researches on the relation of composition to electrical resistance, glasses have been made available for mercury vapour discharge lamps which will permit of their operation at temperatures of 600° and yet have a resistance 300,000 times that of the simple soda-lime-silica glasses used in 1916*, and offering prolonged resistance to blackening.

Not merely in the operations of glass fabrication and manipulation but also in auxiliary processes in its melting, modern physical methods have received valuable application. In the study of the performance of refractory articles in which glasses are melted, X-ray methods of examining structure have often led to vital knowledge; and tensile strength and creep tests at high temperatures, as Dr. Partridge showed, have been of great value.

Some fields of investigation have been but little explored by the physicist. Thus, Dr. Seddon emphasized the lack of systematic information available about certain thermal properties at high temperatures, namely, specific heat, thermal conductivity and emissivity. But sufficient has been said to demonstrate how physics has assisted in transforming glass-making into an enterprising and efficient industry.

* See, for example, Dudding, B. P., *Proc. J. Soc. Glass Tech.*, **22**, 43 (1938).

THE FLORA OF MADAGASCAR

BY DR. J. HUTCHINSON,

ROYAL BOTANIC GARDENS, KEW

FEW naturalists will need reminding that Madagascar, the third largest island in the world, possesses a fauna and flora of exceptional interest. Although only 260 miles distant from the nearest point on the East African coast, its flora bears an almost equal relationship with that of the great continent and that of Ceylon, Malaya and even Australia, whilst its fauna, as pointed out long ago by Alfred Russel Wallace[1], is almost exclusively related to that of Eastern Asia. Of equal interest is the fact that the language of the natives is closely related to those of Malay-Polynesia, whilst another remarkable feature is that they do not employ skins for clothing their bodies as do the natives in Africa, but make use of vegetable fibres as do the eastern peoples.

The distribution and affinities of the animal life, therefore, and of the plants in part, indicate that Madagascar was in former times connected much more closely with the continent of Asia than it is at the present day. As is well known, there are two rival hypotheses which might account for these interesting facts, either the mythical Gondwanaland of Suess, or the continental drift of Alfred Wegener. With respect to its organic life, therefore, Madagascar ranks equally with other oceanic islands such as New Guinea, New Caledonia, St. Helena and the Galapagos in being a 'museum of antiquity'.

Madagascar is nearly a thousand miles long, has an average of 250 miles in breadth and an extreme width of 360 miles. Its area is nearly four times that of England and Wales.

The main features of the island are the great central ridge of elevated ground, the encircling tropical plains, broad on the west side, narrow on the east of the ridge, and with a long girdle of primeval forest nearly 2,000 miles in length. There is fine mountain scenery in the Betsileo country in the southern portion of the island, and in the centre the Ankaratra mountains rise to a height of 9,000 ft. within a short distance of the capital, which stands at 4,000 ft. This central portion consists of rolling moor-like hills covered principally with long grass which becomes very brown and dry by the end of summer.

The flowering season of most plants in Madagascar is October–May, that is, during the rainy season. But many do not flower until December, and the grasses and sedges mostly flower towards the colder dry season, from March to May

The plant that probably leaves the greatest impression on the visitor is the travellers' tree, *Ravenala madagascariensis* Sonn., a banana-like plant, but more closely related to the well-known South African Strelitzia than to the banana (Musa) A beautiful flowering tree is Colvillea, a leguminous plant of the family Cæsalpiniaceæ, with sensitive leaflets like those of a Mimosa, and a dense raceme a foot long of large red flowers with rounded petals.

One of the best known Madagascar herbs is Kitchingia (Crassulaceæ) (united by some botanists with Bryophyllum), which is grown in hanging baskets in our greenhouses It commemorates the late Langley Kitching of Leeds, a missionary who collected plants in Madagascar in 1879.

Until nearly the close of the nineteenth century we knew very little of the botany of the island The great world-exploring expeditions up to that time and to which botanical collectors were attached had mostly given it a wide berth and proceeded direct from the Cape to Indo-Malaya and Australasia, and the opening of the Suez Canal tended to increase this neglect. It was not until 1820, when Christian teaching was commenced by the London Missionary Society, that Europeans gained access to some parts of the island. A set-back soon occurred, however, for on the death of the native King Radama in 1835, missionaries were obliged to leave the country by command of Queen Rànavàlona, the native Christians were persecuted, and for many years all Europeans were excluded and foreign commerce brought almost to a standstill. In 1861, however, the island was reopened to European trade and missionary efforts recommenced, the independence of the country being more or less maintained until 1895, when it became a part of the empire of France.

Botanical exploration did not begin in earnest until about 1880, when large collections began to arrive at Kew from members of the London Missionary Society, mostly made by Mr. Langley Kitching, Dr. Parker and the Rev R. Baron. The last-mentioned, for example, sent to Kew between the years 1880 and 1896 nearly 12,000 specimens (separate gatherings) of plants. These were dealt with by the late Dr. J. G. Baker, then principal assistant in the Kew Herbarium, and the novelties were described by him in the *Journal of Botany* and the *Journal of the Linnean Society*. To these two men, therefore, should be given the credit for laying the foundations of our knowledge of the flora. Baron's plants were particularly valuable because they were collected in the central higher parts of the island, especially the Imerina Province, and many of them proved to belong to genera and species hitherto unknown to science.

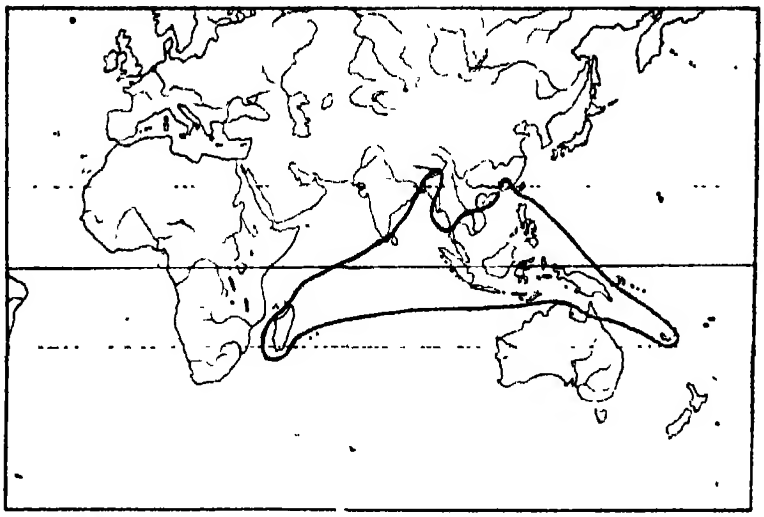
The principal British collector since Baron's time was Mr G. F. Scott Elliot, who explored the southern part of the island in the neighbourhood of Fort Dauphin, and collected more than a thousand plants.

In more recent years large collections have been made by H. Perrier de la Bathie and by the present director of the Paris Botanical Museum, Prof H Humbert, and the mantle borne by Baron and Baker has very appropriately passed to the shoulders of these two French botanists. They also have brought to light many new species and new facts relating to the distribution of Madagascar plants.

In 1936 a "Flore de Madagascar" (Plantes vasculaires) was commenced under the direction of Prof. Humbert, and it would indeed be a tragedy if this important work were to be delayed because of the War In common with other countries, after it is over, France will no doubt need as much detailed knowledge of the vegetable productions of her possessions as possible, and nothing contributes so much towards this end as a well-written and illustrated Flora such as contemplated by the Paris botanists, a portion of which has been published already[2], and further parts are in preparation

For example, Madagascar possesses one of the most remarkable grass floras in the world, including a number of endemic genera of bamboos. Very few of them have so far been investigated for economic purposes. The soil of the plains is described as rich and very fertile and capable of supporting vast herds of cattle, and it should not be forgotten in this respect that the island is about as big as France herself. It is indeed high time that botanists should know more of the flora in a collected form, for up to the present we have only had available miscellaneous papers published in many different journals, from which it has been well-nigh impossible to obtain an adequate idea of the flora as a whole. Then, and then only, will it be possible to study the many interesting phytogeographical problems which the island presents in abundance

I may mention only a few of the more prominent. For example, why is it that there are in Madagascar no species of Mesembryanthemum (*sensu lato*), so numerous in South Africa, when there are in the island numbers of spiny Euphorbias, Pachypodium and xerophytic Asclepiadaceæ, which are such prominent features of the South African vegetation? In addition, such typical South African genera as Halleria (a woody Scrophulariaceous



RANGE OF THE UNIQUE GENUS OF 'PITCHER PLANTS' (NEPENTHES) (AFTER HUTCHINSON "FAMILIES OF FLOWERING PLANTS", VOL. 1)

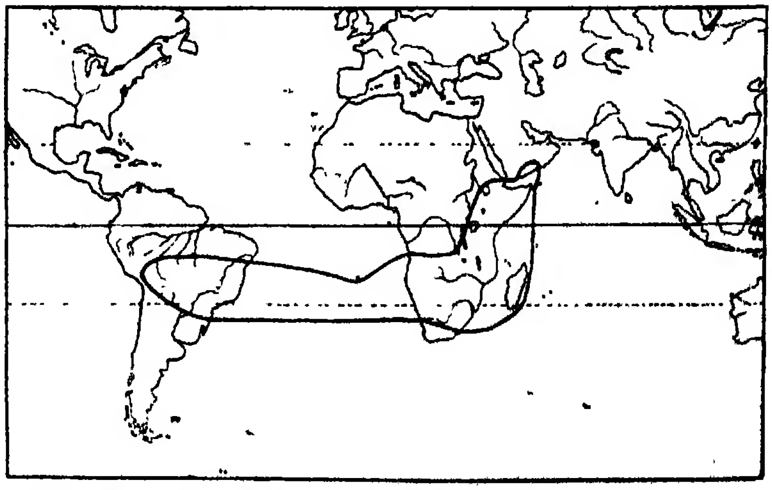
genus), Clematopsis (Ranunculaceæ), Sparrmania (Tiliaceæ), Faurea (Proteaceæ), Peddiea and Dais (Thymelaeaceæ), Kniphofia ('poker plants'), Aloe (Liliaceæ), and Aristea (Iridaceæ), are also prominent in the vegetation of Madagascar.

Again, is Madagascar the original home of the Baobab genus, Adansonia? There are more species in the island than elsewhere, for there is only one in the whole of tropical Africa, and two in northern Australia. This connexion with Australia is mysterious and is reflected again in the case of Hibbertia (Dilleniaceæ), a large Australian genus with two endemic species in Madagascar. And how did the unique genus Nepenthes (pitcher plants) get to Madagascar, all the other species being in Ceylon and through Malaya as far as New Caledonia (see accompanying map)? Ocean currents did not carry them; nor did the flight of birds; nor were the seeds borne on the wings of the wind!

Madagascar has at least two endemic families of plants. These are Chlaenaceæ, related to the great Asiatic tea family, Theaceæ, and Didieriaceæ, the latter being weird spiny plants of fantastic form and uncertain affinity, which have almost to be seen to be believed. At present we know far too little about them until they are more thoroughly investigated in the field and collected.

As stated above, the flora is only in part related to that of tropical Africa. The most striking genera common to the two regions are Brexia (Escalloniaceæ), Dombeya (Sterculiaceæ), Acridocarpus (Malpighiaceæ), Haronga (Hypericaceæ), Uapaca (Euphorbiaceæ), Myrothamnus (Myrothamnaceæ), Agauria (Ericaceæ), Psiadia (Compositæ), Landolphia (Apocynaceæ), Albizzia Sassa (Gmel.) Macbride (Mimosaceæ), and Trachylobium (Cæsalpiniaceæ), the East African copal tree, all genera or species familiar to African but unknown to Indian botanists. Most of these trees and shrubs grow in the great primeval forest which encircles the whole island at a distance of about forty miles from the coast, but which extends right to the sea at the north-west end of the island. According to Humbert, this forest is fast disappearing on account of the shifting native cultivation just as in tropical Africa, and it is of primary importance to biological science that it should be thoroughly explored and comprehensive collections made before it has been destroyed.

An interesting Madagascar-Afro-American connexion is shown by the genus Vellozia (Vellioziaceæ), a distinctive monocotyledon, with shrubby stems and star-like flowers, of which there are several species in Madagascar, tropical Africa and South America, with one in southern Arabia. More surprising in this respect is the recent discovery of a new species of grass belonging to the genus Redfieldia, hitherto monotypic and known



RANGE OF THE GENUS VELLOZIA (AFTER HUTCHINSON: "FAMILIES OF FLOWERING PLANTS", VOL. 2).

only from the United States of North America. Although accepted by agrostologists, this is more likely to be due to convergent evolution such as is common in Compositæ and other large homogeneous families as Cruciferæ, Papilionaceæ, Rubiaceæ, Asclepiadaceæ, and Labiatæ. The grasses also provide a further example of the Indo-Malayan connexions of the flora, for a species of the genus Thuaria (*T. Perrieri A. Camus*), until recently known as monotypic in Indo-Malaya and Polynesia, has now been found in Madagascar.

[1] Wallace, Alfred Russel, "Island Life", 388 (1880).

[2] "Flore de Madagascar" (Plantes vasculaires), publiée sous les auspices du gouvernment général de Madagascar et sous la direction de H. Humbert, Professeur au Museum Nationale d'Histoire Naturelle. Aponogetonaceæ, by H. Jumelle (1936), Cyperaceæ, by H. Chermezon (1937), Lemnaceæ, by H. Jumelle (1937); Commelinaceæ, by H. Perrier de la Bathie (1938); Liliaceæ, by H. Perrier de la Bathie (1938), Bignoniaceæ, by H. Perrier de la Bathie (1939) (Tananarive, Imprimerie Officielle, 1936 →)

FOOD RESEARCH

BY DR. T. F. DIXON

THE Department of Scientific and Industrial Research has recently issued the annual report for 1938 of the Food Investigation Board under the chairmanship of Sir Joseph Barcroft* The report describes experimental work carried out under the general direction of Mr. Eric Barnard, at the Low Temperature Research Station, Cambridge, with sub-stations at Covent Garden and Smithfield, the Torry Research Station, Aberdeen, and the Ditton Laboratory, Maidstone.

The most important development during the year under review has been the expansion of the work of the Board to cover research on the processing of food. A committee has been set up to consider the organization of research in this field in the interests alike of the consumer, producer and manufacturer. As soon as research on processing is considered, the question arises as to whether it should be organized on the basis of the process, for example, canning, or of the raw material, for example, fruit and vegetables or meats. The Board takes the view that it is the research on the raw material that is fundamental.

Although some work has been already carried out on the manufacture of bacon, the smoking and salting of fish and the canning of fruit, the work of the Board had previously been mainly concentrated on the problems involved in preserving the 'fresh' properties of unprocessed food during transport and storage.

Attention is directed to the progress made in the transport of chilled beef from Australia and New Zealand by gas storage, that is, in stores on board ship the air of which is enriched to a controlled extent with carbon dioxide. Until this method of storage was developed meat could not be brought from these distant Dominions to Great Britain in a chilled condition; it had to be frozen. In the five-year period since the method was introduced, the exports to Great Britain from Australia and New Zealand of chilled beef have increased nearly ten-fold to a combined annual figure of 42,500 tons. Since chilled beef has recently commanded a premium of *1d.* a pound over frozen beef, the increased value of this meat is of the order of £400,000. The possibility of improving the 'bloom' or appearance of the meat, which depends on the condition of the layer extending inwards to a depth of about 1/10 inch, by increasing the evaporation of water from the meat during the voyage, is also being investigated. Acidification of flesh occurring after death takes place in two stages. The first, ending at pH 6·2, is dependent on the physiological state of the muscle and is uninfluenced by temperature. The second stage, however, is influenced by temperature and probably represents a straightforward enzymic breakdown of glycogen. Stiffening (rigor mortis) also takes place mainly during the second stage of acidification. The higher the glycogen content at death the lower will be the muscle pH and the firmer the flesh. Liver and muscle glycogen levels are usually much lower in pigs than in oxen.

The average value for the ultimate pH (twenty-four hours or more after death) of the pig psoas muscle has been used as a measure of the muscular fatigue of the animal at the moment of death. A pH of 6·7 is taken as indicating extreme, and a pH of 5·5 or lower an absence of, fatigue. Empirically it has thus been possible to detect fatigue, ascribe the reason for it and devise methods to reduce it. The psoas muscle is more affected by fatigue and therefore almost always has a higher pH than the less deeply seated longissimus dorsi muscle. While the bacon pig is being fattened, an increase in the percentage of fat in the muscular tissue is accompanied by a corresponding decrease in the iodine value of the fat. By greatly reducing the plane of nutrition it has been possible to reduce the fat in muscle to as little as 0·5 per cent.

* Report of the Food Investigation Board for the year 1938. (H.M. Stationery Office.) Pp. 277.

Experiments on the quality of the eggs laid by the hens, White Leghorn and Light Sussex, show that the percentage of thick white is primarily a characteristic of the individual hen and that there is no correlation between it and the season, the rate at which the eggs are produced or their weight. Any method of washing increases the number of rots in eggs, since the organisms responsible for rotting readily penetrate the wet shell, although the permeability of shells varies widely even in successive eggs laid by the same bird

Work on the quality of kippers carried out for the Herring Industry Board shows that the quality of the kipper varies with the content of fat. The fatter the kipper the more palatable it is A large proportion of the kippers made from herrings cured from February to early May would be made from herrings containing less than 8 per cent of fat The abrupt and extensive rise in the content of the fat in June from about 2 per cent to more than 20 per cent has a peculiar effect on the suitability of the herring for kippering The newly acquired fat is apparently held very loosely, runs away readily in the kiln, and the fish is very soft and easily torn, so that great care must be observed in curing. By July, however, consolidation of the fat has taken place and the fish make excellent kippers The great variation in the composition of the herring makes it impossible to avoid great variation in the quality of kippers even should the process of kippering be rigidly standardized

Electrometric and chemical methods have been used for estimating freshness of fish. With haddock, for example, estimation of either di- or trimethylamine can be used to determine the onset of definite staleness, but the course of deterioration before this stage is reached can only be followed by the determination of dimethylamine using a sensitive colorimetric method. The micro-organisms causing spoilage of salted fish known as 'pink' belong to the Serratia and Micrococcus groups. The only method so far found effective for controlling 'pink' is chilling the fish to temperatures below 5° C. During the year members of the staff of the Department's Fish Research Station at Aberdeen spent a period in Norway studying at first hand the methods employed there for the handling and storage of fish and the research on the subject in progress in that country.

During the year, arrangements were made to carry out on behalf of the Government of Palestine a survey of the wastage of oranges during transport. The temperature in the holds is an important feature in the wastage of the fruit, and the main object was to ascertain how far temperature variations were responsible for the wastage and to what extent these temperatures might be improved. Experiments were also carried out on the storage conditions of Palestinian grapefruit after its arrival in England. Further successful experiments on the gas-storage of home-grown pears, apples and broccoli have been carried out. No form of storage for apples can be reckoned successful unless it conserves their flavour, and this is especially important in the case of our finest dessert variety, Cox's Orange Pippin. A full-scale demonstration was arranged to remove any doubt in the trade as to whether this variety developed its full flavour after gas storage Twenty-six tons of Cox's Orange Pippins were put into a gas store at the Ditton Laboratory at the end of September 1937 The composition of the atmosphere of the store was 2 5 per cent oxygen, 5 per cent carbon dioxide and 92 5 per cent nitrogen and was obtained by the removal of the excess of carbon dioxide by a scrubber of commercial design together with controlled ventilation The temperature of storage was 4° C The store was opened on February 22, 1938, in the presence of some 150 fruit-growers and other experts The demonstration was completely successful, the fruit being in excellent condition; in fact 80 per cent of it was graded as 'Fancy' or 'Extra Fancy'

On the other hand, a subsequent survey of fruit of this variety from ten representative areas has shown that the extent to which the flavour is developed depends, in the main, on the pre-storage conditions, such as soil, manurial treatment and maturity at the time of gathering Gas-storage also lengthens the life of home-grown pears of the variety Doyenne du Comice. On removal to air after five months storage, the pears ripen in twelve days at 18 3° C. and in twenty-one days at 10° C It is found inadvisable to store late varieties of apples together with early ripe, that is, post-climacteric varieties, since volatile substances given off by the ripe apples cause a severe 'lenticel' spotting on the other fruit not only in refrigerated gas storage but also in ordinary cold storage. This 'lenticel' spotting can be produced during storage by treating the pre-climacteric apples with ethylene (1 in 500) for 2–3 weeks early in their storage life.

Confirmation of Putterill's finding in South Africa, that ripening of the plum can be stimulated by low concentrations of acetylene, has been obtained in England for the Monarch plum. After storage for three weeks at 4° C., and removal to 18° C., stimulation of ripening by acetylene, ethylene or air which had passed over ripe plums was still possible.

Other research being carried out on behalf of the Board includes work on meat, the preparation of milk fat, the storage of eggs, bacon and hams, including the factors affecting the quality of the pig's carcass, the storage of new potatoes and other vegetables, and problems connected with canning.

OBITUARIES

Sir Hubert Murray, K.C.M.G.

BY the death, on February 27, of Sir John Hubert Plunkett Murray, lieutenant-governor and chief judicial officer of Papua, the British Empire is the poorer for an outstanding figure, and there can be few of those who came into contact with "H.E." who have not felt also a sense of personal loss.

Sir Hubert was born in Sydney in 1861, and after a brilliant university career in England, was called to the Bar. He served with distinction in the South African War; but his real life-work began when he went to British New Guinea in 1904 as chief judicial officer. When this country was placed under Australian administration as the Territory of Papua in 1906, he was appointed acting administrator and shortly afterwards lieutenant-governor. He found himself responsible for a little-known country nearly twice the size of England, populated by a thin sprinkling of white settlers and an unknown quantity of Stone Age savages.

During Sir Hubert's administration a large part of Papua has been opened up. Although as time went on his administrative duties made it necessary to delegate the work of exploration to others, he kept in personal touch with as much of the Territory as he could, and it was on a tour of inspection that he died, after two days' illness, at the age of seventy-eight. But he always regarded as his main task the guidance of the country through the difficult initial stages of adjustment. From the first, he had to contend with the clash of interests between the two types of population, "for if an administrator succeeds in holding the balance even between the white settler and the native, he is open to attack from the partisans of both, and the applause of either will often be a sign that he is acting unfairly to the other". He made it clear, however, that he considered it the duty of the Papuan Government not only to foster the interests of the whites, but also "to show how the civilization of the twentieth century can be introduced among people of the Stone Age, not only without injury to them but to their lasting benefit and permanent advancement".

Taking the long view, Sir Hubert steadily opposed the alienation of any land which appeared necessary to the welfare of the natives, and the introduction of Asiatic labour, although he faced severe criticism on the grounds that he was hampering the development of the country. To meet the reasonable demands of the white settlers for labour, he introduced the indenture system, hoping that free labour might eventually be substituted. He thought that the future of the Papuans, if they were to be more than mere labourers, lay in the cultivation of land for themselves, so he instituted a system of native plantations. He also appointed village councillors, who might gradually be given more authority. At the same time, he realized the harm that can be done to a primitive people by too swift destruction of their old life. His appointment of a Government anthropologist "to help us in reconciling an intelligent, though very backward, race to the inevitable march of civilization, and in finding the easiest way for its advance", has been amply justified.

His books, "Papua or British New Guinea" (1912) and "Papua of To-day" (1925), and his annual reports—very different from the usual lifeless documents—record, though modestly, the course of Sir Hubert's long tenure of office. Some measure of his achievement may be indicated by extracts from two addresses presented to him on the completion of the thirtieth year of his administration. This from the white residents: "Your Excellency's reputation in Native Administration is world-wide and firmly established. What is not so well known outside Papua is the patient, wise and sympathetic manner in which you have worked always for the protection and support of European industries, for the advancement of Papua as a colony, and for the welfare of every member of the community." This from the natives: "When we have come to speak to you, you have not closed your ears, nor have you frowned on us, but have received us and listened to us, and taken action for us. We have seen all the good things you have done and our happiness is great because of you. Therefore we all beg of you not to leave us, but stay here as our Governor for years to come. For we know you and how you have led us into the ways of your laws, treating white people and ourselves just the same. We know that you love us well, and we are full of love for you, our Governor."

B. BLACKWOOD.

Mr. A. L. Tonnoir

BY the sudden death, on January 27, of Mr. A. L. Tonnoir, the Australian Council for Scientific and Industrial Research has suffered an irreparable loss. This loss is shared by the many entomologists throughout the Commonwealth and overseas who have from time to time benefited by his unusually wide knowledge and experience.

André Leon Tonnoir was born in Brussels in 1885. After his formal education at school and at the University of Liège, he spent several years travelling in England, France, Germany, Italy and Spain. During this period he was able to give much of his time to his outstanding interest, entomology, and incidentally to acquire a sound knowledge of six languages. However, it was not until after the War of 1914–18, when he was appointed to the staff of the Brussels Natural History Museum, that he was able to devote his whole time to his former hobby. Like many naturalists, he was especially interested in Australia and New Zealand, and in 1921 he

accepted a commission to study the dipterous insects of the temperate zone of the southern hemisphere, a study which still occupied his leisure hours up to the day of his death.

From Belgium Tonnoir went to New Zealand, where he worked at the Cawthron Institute, the Canterbury Museum, and the Canterbury University College, until 1929, when he joined the staff of the Division of Economic Entomology of the Australian Council for Scientific and Industrial Research in Canberra. During the past ten years he has been closely associated with research on biological control of insect pests and weeds, and has also played a prominent part in the development of an intensive study of the grasshoppers in Australia Mr Tonnoir's numerous papers on lesser-known families of the Diptera do not adequately reflect his remarkable knowledge of insects, although they are a record of the thoroughness of his work and his outstanding ability as a taxonomist.

Tonnoir's death removes a colourful personality and a delightful colleague, but our sadness is tempered by the knowledge that he died as he would have wished, peacefully in his sleep as he rested in the shade of a tree, after a morning's collecting in the bush. A. J. NICHOLSON

Mr. H. G. Newth

MR. H. G. NEWTH, whose death at the age of fifty-four occurred on February 17 after a long illness, went to school in Worcester and then entered the Royal College of Science, London. There he studied zoology under Adam Sedgwick and Mr. Clifford Dobell, and then became demonstrator in zoology for Prof. E. W. MacBride. a post which he held until the War of 1914–18. From 1920 onwards, he was lecturer in zoology in the University of Birmingham.

The early death of Mr. Newth will be deeply regretted by his friends in zoological and other circles, for he had a personal charm which endeared him to his colleagues and his students, generations of whom remember his clear lectures and skilled help in the laboratory. Advanced students profited especially from his embryological teaching, embodying practical experimental work on modern lines.

Mr Newth was a master of microscopical technique and was always more than willing to help other research workers in the laboratory. His own original contributions included work on the embryology of Cucumaria and of Astropecten, on the development of Amphioxus, and on the swarming of Vorticella. Perhaps his most important research was on the mode of feeding of the ammocœte, which he showed to be different from that of any other animal (NATURE, 126, 94; 1930). Mucus secreted by the endostyle-thyroid is moved by cilia forwards and up the peripharyngeal grooves, from which it is freed as a cone of mucous strands, uniting behind to form a mucous cord which lies free in the middle of the pharynx. This cord is continuously sucked back into the gullet by cilia in the latter. Food particles drawn into the mouth with the respiratory water current, which is maintained by muscular movements of the pharynx and of the velum, are caught in the cone of mucous strands and passed back into the gullet in the mucous cord. H. M. F.

Prof. C. Tangl

PROF. CHARLES TANGL, of the University of Budapest, died on January 10 in his seventy-first year. He received his early training in physics at the University of Budapest, where he was student, and later assistant and collaborator of Prof. Eötvös. He was appointed in 1901 as *Privat-Dozent* and in 1903 as professor of experimental physics at the University of Kolozsvár. In 1917 he became professor of physics at the Polytechnic in Budapest, and in 1921 he succeeded Eötvös in the chair of experimental physics at the University of Budapest He was a member and president of Section III of the Hungarian Academy of Science.

Tangl's interests lay in three different branches of physical research. His early work was devoted to the study of the effect of magnetic fields upon the mechanical properties of solid bodies, especially of the effect upon elasticity. Then in several papers he published the results of his investigations upon the variation of the dielectric constant of liquids with pressure and temperature. These experiments, carried out with great care and accuracy, furnished very reliable values of the dielectric constants which are frequently cited. In a third line of work he applied quite new methods to investigate the forces at the contact surface of solid and liquid bodies; the determination of the contact force between platinum and water, in particular, should be mentioned.

Tangl was a man of outstanding personality and wide knowledge. A thoroughly critical judgment was combined with great kindness; he was a helpful friend to all who needed his advice. M. FORRÓ.

WE regret to announce the following deaths:

Prof F. Emich, emeritus professor of chemistry in the Polytechnic Institute, Graz, an authority on microchemistry, on January 22, aged seventy-nine years

Sir Thomas Heath, K.C.B., K.C.V.O., F.R.S., an authority on Greek mathematics, on March 16, aged seventy-eight years.

Prof. A. G Högbom, emeritus professor of geology in the University of Uppsala, on January 19, aged eighty-four years.

Prof. Bernhard Lehmann, emeritus professor of chemistry and director of the Institute of Hygiene in the University of Würzburg, on January 28, aged eighty-two years.

Prof. W. C. Morgan, professor of chemistry in the University of California at Los Angeles, on February 9, aged sixty-five years.

Dr. A. J. R. O'Brien, C.M.G., chief medical adviser to the Colonial Office, on March 9, aged fifty-six years.

NEW FELLOWS OF THE ROYAL SOCIETY

At a meeting of the Royal Society on March 14, the following new fellows were elected:

Dr. W. T. Astbury, reader in textile physics in the University of Leeds, distinguished for his pioneer researches into the structure of natural fibres and proteins. His chemico-X-ray technique has opened up new fields of knowledge.

Dr. G. R. de Beer, reader in embryology, University College, London, distinguished for his original contributions on the embryology of vertebrates, which are notable for their completeness and accuracy.

Dr. O. M. B. Bulman, University lecturer in palæozoology, Cambridge, distinguished for his work on Lower Palæozoic stratigraphy, especially on the morphology, ontogeny and phylogeny of the Graptolites, and their geological history.

Lord Cadman of Silverdale, chairman of the Anglo-Iranian Oil Company, emeritus professor of mining and petroleum technology, University of Birmingham, distinguished for his many public services and for his leadership—administrative and scientific—in the development of the Iranian oilfields

Prof. G. Cook, regius professor of civil engineering and mechanics, University of Glasgow, distinguished for researches into a wide variety of engineering problems and particularly for original investigations into the stress–strain relations of metals when passing from the elastic to the plastic state under systems of combined stresses.

Dr. H. Davenport, lecturer in mathematics, University of Manchester, distinguished for his work in pure mathematics and particularly for his contributions to the theory of numbers.

Dr. C. F. Goodeve, reader in physical chemistry, University College, London, distinguished for his work in many branches of physical chemistry and particularly for his contributions to our knowledge of absorption spectra and photo-chemistry.

Prof. F. G. Gregory, professor of plant physiology, Imperial College, London, distinguished for his researches on the analysis of plant growth, especially in relation to mineral nutrition and vernalization.

Prof. A. C. Hardy, professor of zoology and oceanography, University College, Hull, distinguished for his researches on marine biology and their application to fishery problems, with special reference to the ecology of the herring and the distribution of plankton.

Dr. C. H. Kellaway, director of the Hall Institute for Medical Research, Melbourne, Australia, distinguished for his researches on snake venoms and on protective antisera.

Prof. K. S. Krishnan, Mahendralal Sircar research professor of physics in Calcutta, distinguished for his researches in optics, and especially for his study of the influence of magnetism on crystals.

Prof. R. P. Linstead, professor of organic chemistry in Harvard University, distinguished for work in synthetic organic chemistry, including reversible isomeric change, ring compounds and phthalocyanines.

Prof. O. Maass, MacDonald professor of physical chemistry, McGill University, Montreal, distinguished for his researches in physical chemistry, particularly those relating to the properties of gases and liquids, during which he has detected and studied an important and anomalous behaviour in the critical region.

Prof. H. S. W. Massey, Goldsmid professor of mathematics, University College, London, distinguished for his work in mathematical physics and particularly for his contributions to the quantum theory and its applications to physics.

Dr. B. H. C. Matthews, assistant director of research, physiological laboratory, and fellow of King's College, Cambridge, distinguished for his work on electrophysiology, particularly in connexion with the sense organs and the spinal cord, by which important factors in the mechanism of the nervous system have been revealed.

Prof. W. H. Pearsall, professor of botany, University of Sheffield, distinguished for his investigations on the determination of the factors underlying the distribution of aquatic plant communities, especially in the British lakes, and on the conditions affecting algal metabolism.

Dr. J. H. Quastel, biochemist to the Cardiff City Mental Hospital, distinguished for his work on chemical reactions in resting bacteria, the mode of action of enzymes, the chemical metabolism of the brain, and the action of drugs.

Prof. A. Robertson, professor of mechanical engineering, University of Bristol, distinguished for his fundamental contributions to knowledge relating to the stability and strength of solid and tubular struts, and to many other problems in the field of the strength of materials of engineering construction.

Dr. L. F. Spath, lecturer in geology at Birkbeck College, University of London, distinguished for his researches on the phylogeny of the Nautiloidea, the goniatites and the ammonites, and particularly on the problems of ontogeny and recapitulation in cephalopods.

Dr. W. Sucksmith, reader in magnetism, University of Bristol, distinguished for his outstanding experimental researches, particularly on the gyromagnetic effect of paramagnetics and the physical properties of ferromagnetics.

NEWS AND VIEWS

Finland and the U.S.S.R.

HOSTILITIES between these countries have ceased, and a peace has been signed which gives the U.S.S.R. substantial territorial gains. Finland loses much of her industrial and agricultural areas by this treaty, and nearly half a million of her population are being transferred from the ceded territory to other parts of Finland. The country has suffered a grievous blow, not through any lack of valour, but through the overwhelming military power of the U.S.S.R. Now the Finns have turned with characteristic courage and energy to the task of reconstruction. Towns and houses destroyed by aerial bombardment have to be rebuilt, new towns created for the transferred people, and the whole of the economic life of the country has to be restarted under the new conditions, while the defence of the new frontiers must also be organized. The Finns have saved their freedom, and on this the nation will rise again. The help in men, money and materials still so sorely needed will surely not be grudged by right-thinking peoples who have watched the struggle of this gallant democracy.

Water Pollution Research

THE Department of Scientific and Industrial Research has opened a new Water Pollution Research Laboratory at Watford equipped for work on the problems of water supply, sanitation, and the recovery and utilization of valuable materials from trade effluents of many kinds. Plans for building a research station for work of this nature have been postponed by the War, but temporary accommodation has now been obtained. Although no central research station has hitherto been available for the work of the Water Pollution Research Board, many investigations have been carried out in the last few years, on behalf of the Board, in other laboratories. Among other important work, it has been shown that certain clays and glauconitic sands found in Great Britain yield material capable of softening hard water, and that certain synthetic resins can be used to remove dissolved salts and other substances from water.

The Board has also co-operated with industry in the investigation of river pollution by beet sugar and milk factory effluents. Another important investigation was that on the effect of the discharge of sewage into the estuary of the River Mersey on the deposition of silt and other solid matter in the estuary, and an investigation is now in progress at a branch laboratory in Birmingham, in co-operation with the Birmingham Tame and Rea District Drainage Board, which has indicated that the capacity of percolating filters for treating sewage can be increased by at least 50 per cent. Communications intended for the Director of Water Pollution Research should be addressed to the Water Pollution Research Laboratory, Langley Road, Watford, Hertfordshire.

Radioactive Standards

RELIABLE standards of weak radioactivity are required in a number of fields of work; for example, by geologists, geophysicists and cosmologists concerned with the radioactive content of the materials of the earth's crust; by biological and medical investigators employing the technique of radioactive indicators or internal artificial radioactivity therapy; and in studies of radium and thorium poisoning. A committee of the United States National Research Council is endeavouring to facilitate the needs of such workers by preparing a series of feebly radioactive standards which will be analysed at a number of laboratories equipped to make such measurements. These standards will ultimately be deposited at, and certified by, the National Bureau of Standards at Washington, D.C., to be issued as working standards to investigators who may desire them.

The standards in preparation are: (1) *Radium standards*, comprising 100 c.c. solutions in sealed flasks, for use as emanation standards; and 5 c.c. solutions in sealed ampoules for use as gamma-ray standards. (2) *Thorium standards* in the form of sealed ampoules containing sublimed thorium chloride for use in preparing standard thorium solutions. (3) *Standard rock samples* consisting of a variety of finely ground minerals of certified radium and thorium content, which may be used in fusion techniques for checking methods of extracting radon and thoron from rock samples.

Drug Addiction

IN a paper read at an evening meeting of the Pharmaceutical Society on March 12, Dr. Walter B. Kennedy, a member of the Poisons Board and formerly professor of physiology in the University of Baghdad, made some interesting references to the influence of habit-forming drugs brought to his notice in the Near East and elsewhere. A topical and important aspect of drug addiction is the problem of marihanha, the name by which the hemp plant, *Cannabis sativa*, is known in the United States. Marihanha, said Dr. Kennedy, is destructive of the moral sense: "Under its influence there develops a ruthlessness rarely encountered under other conditions, and a spurious courage, or rather a complete disregard for danger and consequences which results in horrible crimes of violence—often devoid of motive. An additional danger is that the addict is often led into indulgence in the white drugs, morphine, heroin and cocaine". Another exotic drug which has lately found its way to Europe is mescal or peyote, obtained from a Mexican cactus. It is an inebriant producing even more brilliant and prolonged hallucinations than does hashish.

Dr. Kennedy referred to the excessive use of endocrine products of which evidence was seen occasionally; he mentioned in this connexion the

fashion which swept through a girls' school of taking thyroid for the purpose of securing lithe figures, a fashion which had serious results in several instances. There is a wide gap between marihuana and thyroid and a still wider one between the former and aspirin. "I may surprise some," said Dr. Kennedy, "if I refer to aspirin as a drug which gives rise to habit, and without being dogmatic I would merely give my opinion that it does". Another form of addiction, he said, was provided by certain medicated wines. Many people delude themselves with the idea that when a wine was 'medicated', it was somehow free from the stigma of what is picturesquely called the 'demon drink'. But there is no excuse for marihuana and no quarrel with the penalty which may be imposed in the State of New Jersey upon traffickers in this woeful drug, namely, thirty years imprisonment and a fine of ten thousand dollars.

Twenty-five Years of Transcontinental Telephony

IT is recalled in the *Laboratories Record* of the Bell Telephone System that on January 25, 1915, just twenty-five years ago, the first transcontinental telephone call was made across America and the east and west were united. President Woodrow Wilson talked from the White House across the country testifying to the nation's pride "that this vital cord should have been stretched across America as a sample of our energy and enterprise". The inventor of the telephone, Alexander Graham Bell, in New York, repeated across the continent to San Francisco the first words ever heard over a telephone, namely, his call to his assistant, "Mr. Watson, come here, I want you," to the same T. A. Watson who had heard them in the garret workshop in Boston in 1876. That ceremony ushered in transcontinental service twenty-five years ago. At that time it cost 20.70 dollars to call San Francisco from New York. Now it costs 6.50 dollars for a station to station call and only 4.25 dollars after seven in the evening and all day on Sunday. In 1915 it took about half an hour, on the average, to make a connexion; now most calls are put through without 'hanging up'. The Bell System concludes by saying: "These are measures of progress in the never-ending effort of the Bell System to give faster, clearer, more useful and courteous service to the people of the United States".

Development of the Battery Vehicle

IN an article contributed to the *Electrical Review* of February 16, J. H. Cansdale states that during the last six years the number of battery vehicles has been rapidly increasing, and war-time conditions will most probably create a very much greater demand for them. In 1933, the number of battery vehicles registered in Great Britain and Northern Ireland was about 1,400, and it is estimated that the number at the beginning of this present year was about 6,500. Any service with short runs and frequent stops, particularly with loads between five and thirty cwt., is suitable for the battery vehicle. A large proportion of tradesmen's and similar services in towns and suburban districts comes within this category. The great advantages of the electric vehicle in lower running and maintenance costs are now augmented by the absence of restriction on the use of electric power for battery charging, in contrast with the present petrol restrictions.

The design of modern battery vehicles has been modelled closely on automobile practice. The weight of the battery necessitates a rather heavier frame, and special provision has to be made for accommodating the battery crates and for their easy inspection and removal. Four-wheel brakes are standard, and the drive to the back axle is by means of a propeller shaft with either a double-reduction bevel or worm gear. Pneumatic tyres of the medium pressure type have been found to give the best results by combining smooth running with economical power consumption. All the principal battery manufacturers now market special traction types able to withstand vibration and to provide heavy starting currents. Of the two principal types available, the lead-acid cell is most usually employed as its first cost is less than that of the alkaline battery. On the other hand, the latter has a life of about nine or ten years, whereas a lead-acid cell lasts only three or four, so that the difference in cost is levelled out. Owing to its higher internal resistance, the alkaline cell has a lower efficiency. For the small delivery van of the 12–15 cwt. class, the normal range of battery capacities is from 129 to 290 ampere hours. Capital costs are heavier than for an equivalent motor vehicle, but the life is approximately double, and both maintenance and running costs are considerably reduced.

Indian Sculpture and Architecture

THE Madras Government Museum has recently issued two publications, one of which is a guide to the archæological galleries of the Museum and is intended as an introduction to South Indian temple architecture and sculpture, while the second contains an illustrative series of photographic reproductions of examples of Indian sculpture, mostly southern, for use with the guide ("Guide to the Archæological Galleries". By Dr. F. H. Gravely and C. Sivaramamurti and other curators. Madras Government Press. Pp. v + 48 + 4 plates. 8 annas. "Illustrations of Indian Sculpture, mostly Southern, for use with the Guide to the Archæological Galleries". By Dr. F. H. Gravely and C. Sivaramamurti. Pp. ii + xlv plates. Rs. 1.8). In the introductory remarks anticipating the text of the Guide, the principle is laid down that "The display of museum collections to the public aims at fostering a deep and intelligent interest in the universe of which we form a part, especially our immediate surroundings", and it is added that the arrangement and display of this section of the Museum's exhibits have been attempted in such a way as to help visitors "to recognize for themselves the general affinities and probable period of temples and sculptures they see outside". With this praiseworthy objective, the authors sketch briefly the history of Indian art from the time of Asoka and in the centuries before our era down to the 'modern' period, with

abundant references to the photographs and casts illustrating the Northern Schools, as well as to the actual exhibits from those of the South, special attention necessarily being directed to the Gupta period and Amaravarti.

No stronger plea than that afforded by these guides could be put forward for the adoption of a vigorous forward policy on the educational side throughout the museums of India. As the report of the Museums Commission showed, these institutions are already places of popular resort; but it depends upon the arrangement and administration of the museum itself whether they are mere repositories of 'curios', or really serve to bring home to the people the continuity in spiritual meaning underlying objects and buildings and structures familiar to them in their daily life. In the East, the function of the archæological museum is concerned with things of which the spirit, and sometimes, if not always, the form, is still alive.

Instructional Films in India

MR. C. F. STRICKLAND has recently published a paper on "Instructional Films in India" (*J. Roy. Soc. Arts*) They supply a ready means of education in a country which "it is not possible to make literate in the next ten years", though during that period instruction concerning good government must be acquired. Adults have to be educated and already Bengal is credited with 1,000 cinemas and 500 touring companies. But most of the films shown are non-Indian and 45 per cent of them are American. They are predominantly unsuited to Indian ideas and modes of thought. Indians do not think continually "in terms of sex emotion or crime" Some educational films are now made in India and several are on loan, but these are meant chiefly for the juvenile population. Mr. Strickland explained the requirements and limitations of the Indian adult, one of which is a pace much less rapid than that to which we are accustomed This speed with perpetual excitement is, we note, quite unnatural, lacking the tension and relaxation which prevail in life and in the best stories of action, such as the "Three Musketeers". It is, in fact, the consequent strain on the mind which makes these pictures so easily forgotten.

Totaquina

IN a recent paper (*Asiatic Res*, 35, 777; 1939), M. Ciuca states that in its search for an anti-malarial preparation cheaper than quinine but equally efficacious, the Malaria Commission of the League of Nations instituted research into the efficacy, compared with that of quinine, of a certain number of secondary alkaloid mixtures, such as kinetum, chineto, cinchona febrifuge, etc., used in the treatment of malaria in various countries. Research carried out in more than 4,000 patients in malarious countries proved that the efficacy of preparations containing 60–80 per cent crystallizable alkaloids including 15 per cent quinine was equal to that of quinine alone. The Commission has given the name of 'Totaquina' to a new preparation which is a mixture of cinchona bark alkaloids containing at least 75 per cent crystallizable alkaloids and not less than 15 per cent quinine. The advantage of the new preparation is a distinctly lower price, which is mainly due to the method of extraction, while its efficacy is equal to or only slightly less than that of quinine.

Seeing at Night

A PAPER by R. G. Hopkinson, of the Research Laboratories, General Electric Co., Ltd., published in the *Electrical Review* of March 1, on "Seeing at Night", shows that valuable progress has been made on this important subject during the last few years, especially in connexion with black-out conditions Under weak illumination, the response of the eye is quite different from that under normal conditions So far as light is gathered by the lens of the eye and is brought to a focus upon the retina, it functions like a camera, the retina acting like a photographic plate in recording the scene for the brain to interpret. The retina is provided, however, with two separate kinds of receptor nerve cells, the 'cones', which usually respond to bright scenes, and the 'rods', which respond to dark scenes. In daylight the cones only function With bright artificial light both rods and cones are working, the rods recording the shadows and the cones recording the highlights for the brain. Under black-out conditions the rods alone are functioning

Black-out vision is much inferior to day vision for the following reasons. (1) The rods do not record colours, hence black-out vision is devoid of colour sensation; all colours appear as varying grades of black and grey. (2) There are fewer rods per unit area of the retina than there are cones. The effect is analogous to that of a newspaper reproduction of a photograph, which is made up of a number of dots and is therefore less clear than the original. This handicap is the more serious since it is just that region of the retina which normally receives the clearest image, the fovea centralis, where the rods are fewest Hence, as many must have noticed at low illuminations, vision is often better around the periphery of the eye

New Commercial Fruits in the United States

O. ATKINS writes in the *American Fruit Grower* (Dec. 1939) on the utility of the wild dryland blueberry (*Vaccinium vacillans* Kalm) in relation to soil conservation. Experiments have shown that it has unusual erosion-resistant qualities on account of its underground shoots, which send out a mass of fine roots and bind the soil together over a large area. In addition to this useful property, the blue-black fruits promise to form a successful commercial crop, and as the plant will grow and fruit in partial shade or full sunlight it is well suited to 'hill-culture'. A systematic breeding programme is being undertaken by the U.S. Department of Agriculture and Soil Conservation Service.

The papaya (*Caprica papaya* L.), according to S. J. Lynch, writing in the same journal, is now being grown commercially in South Florida. The texture of the flesh is similar to that of a

cantaloupe, yellow to reddish-orange in colour, with a sweet musky flavour. The fruits, which vary in size from a few ounces to 25 lb. in weight, contain 5-6 per cent of sugar, no starch, and appreciable amounts of vitamins A, B and C. The proteolytic enzyme papain, which also occurs in the fruit, is used in many commercial products as an aid to digestion. Numerous food and drink products are being made from the fruit pulp. The plant will bear for three or four years, but is treated commercially as an annual, since the finest fruit is obtained in the first year. Both monœcious and diœcious plants occur, which makes standardization difficult; but breeding work is being carried out to establish uniform strains.

Poultry Rations in War-time

COMMERCIAL poultry-rearing has reached a high state of efficiency, and part of that efficiency is expressed in a standardized ration, in which only food ingredients are used which have been proved to be best suited for their purpose. Under war conditions the accustomed standardized ration must be given up, since the amount and nature of feeding stuffs available for livestock becomes restricted, partly because of a reduction in imported supplies and partly because of the wider use of home-grown cereals for human consumption. Poultry-keepers are urged to exercise the greatest economy in the use of such imported materials as maize, and in order that the accustomed ration may be replaced by satisfactory substitutes the Ministry of Agriculture and Fisheries has issued, as one of its "Growmore" Leaflets (No. 14), a summary account of materials which may be used in rearing, growing or breeding rations. The list includes thirty-one different food materials, and the feeding value and method of using each stuff is stated briefly. Single copies of the leaflet—"Poultry Rations in War Time"—may be obtained free of charge and post paid on application to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Birds of the Fenland

CHANGES in the kind and distribution of the animals of the countryside which have been brought about by the progress of civilization are greater than is generally supposed, although often they are difficult to trace in detail. A short account of such changes as they have affected birds in the Fenland appears in the winter issue of *Bird Notes and News* (p. 198), the journal of the Royal Society for the Protection of Birds. In it Francis E. R. Peach, having quoted some early references to the bird-life, compares the earlier fauna with that of the present day, and shows that the general trend in the Fen area has been in the direction of a decline in ducks, geese, waders and birds of prey as drainage proceeded, and an increase in small birds such as linnets, yellow buntings and skylarks which now occupy the reclaimed marsh lands. Surely it is an omission that in dealing with the bird-history of this region the author does not refer to the invaluable "Early Annals of Ornithology", by the late J. H. Gurney, himself a Norfolk man.

Dutch Biology

A. VAN LEEUWENHOEK is known to every biologist as the name of a most eminent Dutch man of science, but we doubt whether many know that it is also the name of a worthy journal of Dutch microbiology, in spite of the fact that five volumes of it have already been published. This is in large measure due to its having appeared in the Dutch language, which has prevented its being read by more than a few English workers. We are glad to welcome its appearance in a new form. The editors and the Board of the Netherlands Society of Microbiology who are responsible for it have appreciated this difficulty, and from volume 6, No. 1, January 1940, it appears under the title *Antonie van Leeuwenhoek, Journal of Microbiology and Serology*, with English, French and German as the official languages. Thus the present number contains seven papers, five in English, one in French and one in German. Its pages are thrown open to workers of any nationality, and the editors hope that, in spite of the present inauspicious conditions, it will serve a wider public.

Demography of England and Wales

IN the third quarter of 1939, 161,201 live births were registered, or 3,119 more than the number recorded in the corresponding quarter of 1938. Of the total 6,458 were illegitimate, or 13 less than in the third quarter of 1938. The deaths numbered 103,170, and were 17,263 less than in the preceding quarter, but 568 more than in the third quarter of 1938. The mortality of infants under one year of age was equal to 39 per thousand registered live births. This rate is 8 per thousand below the average of the ten preceding third quarters and is the lowest quarterly rate ever recorded. The number of persons married in the third quarter of 1939 was 304,716, an increase of 72,084 on the number in the corresponding quarter of 1938. This number corresponds to an annual rate of 29·3 per thousand of the estimated mid-year population for 1938, and is the highest rate yet recorded.

X-Ray Photography of the Renal System

In order that X-ray photographs of the renal pelvis and ureters may be obtained, it is necessary to employ a substance which, after injection into the veins, is excreted by the kidneys and is opaque to the rays, so that a shadow picture of the excretory apparatus of the kidneys may be obtained; further, such a substance must have no harmful effect. A new preparation has been introduced by Glaxo Laboratories, Ltd., under the name of "Pyelectan", which it is stated possesses the necessary properties in marked degree. Chemically, it is the sodium salt of a complex iodine-containing dicarboxylic acid, the iodine content being 51·5 per cent. Pyelectan is claimed to have a low toxicity and to be generally well tolerated, rapidly excreted by the kidneys and yielding a dense and well-defined shadow in the renal pelvis and ureter.

Science Abstracts

THE reduction in thickness of the monthly issues of *Science Abstracts* during the last few months of 1939 will have prepared readers for a reduction of the number of abstracts in the volumes now completed for the year. Section A (Physics) contains 4,725 abstracts, a reduction of 7 per cent on the volume for 1938, and Section B (Electrical Engineering) 2,811, a very noticeable reduction of 22 per cent. Both have established for themselves international reputations as reliable records of yearly progress in the sciences with which they deal, and as indispensable to those who would keep themselves up to date.

Parliamentary and Scientific Committee

THE Earl of Dudley has been re-elected president of the Parliamentary and Scientific Committee for the year 1940. The other officers elected are: *Vice-President*, Captain S. F. Markham, M.P.; *Chairman*, Captain L. F. Plugge, M.P.; *Vice-Chairman*, Prof. B. W. Holman; *Deputy Chairman*, Mr. E. W. Salt, M.P. The Committee has recently had under consideration the question of the release from military service of certain skilled technicians and scientific workers for other work of vital national importance, and also the question of suitable employment being given to technical and scientific workers who have enrolled for military service. At the next meeting of the Executive Committee of this body the question of the collection and utilization of town refuse and waste products will be considered.

Earthquakes during February 1940

AT Kew, Basle, Chur, Zurich and Neuchâtel the registrations of earthquakes tended to show that the earth was seismologically less active than normal during February 1940. At Kew only ten notable shocks were registered during the whole month, the greatest being the three of February 7, 20, and 29. At the Swiss observatories, seventeen shocks were registered, though only nine sets of readings were sufficiently clear to obtain epicentral distances, two of these being doubtful. Distant earthquakes giving consistent readings were those of February 7, 23, and 29, the four others being much nearer to the Swiss stations. Fairly good readings were obtained at Kew for the earthquake of February 23 and at the Swiss observatories for that of February 20, but epicentral distances were not determined.

The greatest earthquakes during the month thus appear to have been those of February 7 and 29. The former, according to the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association, on the basis of reports from seventeen stations, had its epicentre near lat. 52° N., long. 174·5° E., and its initial time 17h. 15m. 56s. G.C.T., with normal depth of focus. This point is immediately to the south-east of Near Island in the Aleutian Islands group and close to the undersea escarpment, where the depth of sea quickly falls to more than seven thousand metres, according to the U.S. Geographical Society map. Although the Aleutian Islands are known to lie along a seismic belt, the region appears to have been more than normally active since the 'missing' earthquake of November 10, 1938. The earthquake of February 29, according to the Zurich seismologists, had its epicentre near lat. 45° N., long. 27° E., which is in Rumania, approximately midway between Bucharest and Galati. On the same authority the earthquake just after 1 a.m. on February 9 had its epicentre near Mont Blanc, and the earthquake of February 23 in Albania. All the above epicentral determinations are tentative.

Announcements

DR. L. E. H. WHITBY has been awarded the John Hunter Medal and Triennial Prize of the Royal College of Surgeons for his research work in "Bacteriology with special reference to the Sulphonamide Compounds".

THE office of the Royal Society has now returned to the Society's apartments in Burlington House and the library is re-opened. Communications, therefore, should be directed to the Royal Society, Burlington House, London, W.1.

THE British Association announces that the grounds of Down House, Charles Darwin's home at Downe, Kent, will be open to the public free of charge from Good Friday onward, from 10 a.m. to 6 p.m.

THE sixth Australian Medical Congress, which was to have been held at Perth, Western Australia, during September 2–7, 1940, has been postponed indefinitely.

THE herbarium of indigenous medicinal plants which is being collected at Calcutta under the ægis of the School of Tropical Medicine now contains 1,500 species, or approximately 5,000 specimens. It is hoped that when the herbarium is completed it will comprise specimens of all the 2,500 medicinal plants known to be growing in India.

DURING the first six months of 1939, 313,226 marriages took place in the old German Reich, or 10,122 (3·3 per cent) more than in the corresponding period of 1938 (303,104). In the second quarter of 1939 there were 11·2 marriages for every 1,000 inhabitants. In the same period there was a remarkable rise in the number of marriages in the former Austria, namely 28,490, or 8,921 (45·6 per cent) more than in the corresponding period of 1938. In the first half of 1939 there were 59,210 marriages in the former Austria, or 28,954 (95·7 per cent) more than in the corresponding period of 1938 (30,256).

ERRATUM.—Dr. Julian Huxley points out that the title of the substance of his British and American Association Lecture published in NATURE of March 2, p. 330, should have been "Science, War and Reconstruction".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 466. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Production of Synthetic Mycorrhiza in the Cultivated Cranberry

UNDER this title, Bain[1] describes experimental investigations on mycorrhizal relationships in *Vaccinium macrocarpon*, Ait., *V. canadense*, Kalm, and two ericaceous species, reviewing and criticizing the conclusions of earlier observers in the light of his own results. In so far as the latter relate to *Vaccinium macrocarpon*, they may be summarized as follows A fungus, specifically distinct from those associated with the other species studied, was isolated from roots of the cranberry, *Vaccinium macrocarpon*. Identity of this fungus with that forming mycorrhizal complexes in the root cells of the host was established by inoculation of the mycelium into pure cultures of cranberry seedlings growing in nutrient agar and in 'artificial soil' composed of cork and sand.

Bain describes the colonies and mycelium of this fungus as 'specifically distinct' from those isolated by him from the other species investigated, and also from those of *Phoma radicis callunæ* obtained from the Centralbureau voor Schimmel Cultures in Baarn Its affinities and systematic position have not been determined.

Designation and acceptance of *Phoma radicis* as the mycorrhizal associate of Vaccinium spp. and members of Ericaceæ rest on the following evidence. In 1907, Ternetz[2] reported the isolation of distinct strains of what was regarded as a single fungus species from roots of a number of native ericaceous species and from *Vaccinium Oxycoccus* and *V. Myrtillus*, all growing in Switzerland. Sporing cultures of all these fungi were submitted to Lindau and Hennings in Berlin for identification and were referred by them to the genus Phoma as a new species under the name *P. radicis*. The form associated with the European cranberry, *Vaccinium Oxycoccus*, like the others, was distinguished in culture by definite characters relating especially to the numbers of pycnidia produced, manner of fruiting, and size and shape of pycnidia and spores.

In 1915, one of us[3] reported the isolation from seeds of *Calluna vulgaris* of a fungus identical in all respects with the form of *P. radicis* described by Ternetz as the mycorrhizal associate of this plant. Subsequent observations on *Vaccinium Oxycoccus* and *V. macrocarpon* were concerned only with systemic infection of the vegetative parts and seeds; isolation of the root fungus was not attempted in either species of Vaccinium. It was tacitly assumed in this paper on Vaccinium that the mycorrhizal fungus present in roots of the native cranberry, *V. Oxycoccus*, was *Phoma radicis Oxycocci* as described by Ternetz for this species in Switzerland, and this assumption was extended to the closely similar N. American species, *V. macrocarpon*, simultaneously under observation.

Although Bain's results do not necessarily constitute a direct challenge, they introduce uncertainty, as to the correctness of Ternetz's conclusions in respect to the identity of the mycorrhizal associate of *V. Oxycoccus*, and to the validity of the subsequent tacit acceptance of this view and its extension to *V. macrocarpon*; it was evident from study of Bain's paper that a re-investigation of this matter on British material of *V. Oxycoccus* was desirable. The results of such investigation are hereby placed on record

Freshly lifted roots of *V. Oxycoccus* were washed in running water, sterilized by immersion in 1 per cent hydrochloric acid or 0·01 per cent mercuric chloride for 15–20 seconds, and rinsed repeatedly in sterilized water. Small pieces of roots so treated were then transferred to tubes of various media, including that used by Ternetz. A majority of these platings developed pure culture colonies of greyish white mycelium, becoming pinkish brown to dark brown with age. After two to three weeks growth at room temperature, these colonies fruited, forming pycnidia of various sizes in and upon the substrate. In all respects—character of colonies and mycelium, numbers and mode of formation of pycnidia, and size and characteristics of pycnidia and pycnidiospores—this fungus resembles *Phoma radicis Oxycocci* as described by Ternetz.

We are greatly indebted to Dr. J. Ramsbottom, keeper of botany, British Museum (Natural History), for examining our cultures and confirming the identity of the root fungus isolated by us with that extracted by Ternetz from Swiss material of *V. Oxycoccus*. A similar investigation is in progress on garden material of *V. macrocarpon*.

It may be added that root material treated as described by Bain, by repeated washings in distilled water without surface sterilization, gave rise in all cases observed by us to colonies of unidentified fungi, usually yellow or orange in colour.

Full discussion of Bain's conclusions in respect to this matter and to his views respecting the nature of the mycorrhizal associations in Ericaceæ must await a convenient occasion. In justice to the pioneer observations of Ternetz, it is desired to place on record these relating to the cranberry fungus as soon as possible.

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[1] Bain, Henry F., "Production of Synthetic Mycorrhiza in the Cultivated Cranberry", *J. Agric. Res.*, 55, 811–836 (1937).

[2] Ternetz, Charlotte, "Über die Assimilation des atmosphärischen Stickstoffes durch Pilze", *Jahrb. wiss. Bot.*, 44, 353–408 (1907).

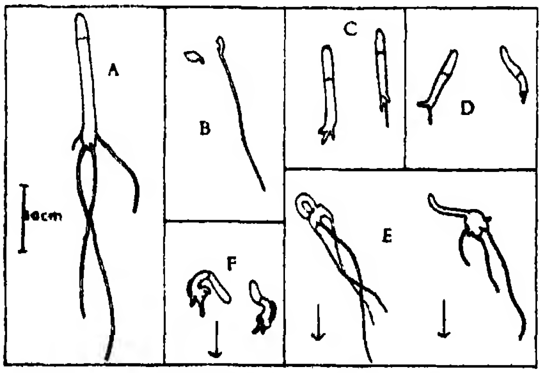
[3] Rayner, M. C., "The Biology of Fungus Infection in the Genus *Vaccinium*", *Ann. Bot.*, 43, 55–70 (1929).

Vernalization of Fragments of Embryo Tissue

EMBRYOS of cereal grains, separated from the endosperm and cultured on a medium containing sugar, can be vernalized by exposure to a temperature of 1° C. in the same way as whole grains[1,2,3,4]. In order to locate more precisely the tissues concerned in the process, embryos of Petkus winter rye were mutilated in various ways before vernalization treatment. In this preliminary experiment only two embryos were subjected to each type of mutilation.

	Treatment	No. of replicates	Condition of plants 84 days after end of treatment
A.	*Vernalized 6 weeks*		
1	Whole embryos	7	All past anthesis
2	Stem apex and fourth leaf retained	2	Both with ears emerged
3	Scutellum removed	2	One vegetative, one shooting
4	Scutellum and shoot apex removed	2	No plants obtained
5	Scutellum and roots removed	2	One with ear emerged, one shooting
6	Scutellum and coleoptile removed	2	One with ear emerged, one vegetative
B	*Vernalized 2 weeks*		
1	Whole embryos	14	All vegetative

The fragments were planted on agar medium containing 2 per cent sucrose, vernalized at 1° C. for six weeks, and after eight further days growth on the medium at a temperature of approximately 18° C., were large enough to be planted out. The appearance of the fragments at the end of the vernalization period is shown in the figure. The removal of the coleoptile has the curious effect of promoting hypertrophy of the tissue about the roots, and there is, in addition, a lack of gravity perception in the first leaf. Possibly the latter effect is simply due to the absence of the mechanical support of the coleoptile, but it is interesting to note that whole embryos, germinated on 2 per cent sucrose with the addition of 1/10,000 hetero-auxin solution, show a similar failure of gravitational response as well as the hypertrophy of the coleorrhiza (see accompanying figure, *F*).



CAMERA LUCIDA DRAWINGS OF EMBRYO FRAGMENTS AT END OF SIX WEEKS VERNALIZATION AT 1° C. *A*, COMPLETE EMBRYO, *B*, STEM APEX AND FOURTH LEAF INITIAL; *C*, SCUTELLUM REMOVED; *D*, SCUTELLUM AND ROOTS REMOVED; *E*, SCUTELLUM AND COLEOPTILE REMOVED; *F*, COMPLETE EMBRYOS GROWN FOR SIX WEEKS AT 1° C. ON MEDIUM CONTAINING 1/10,000 HETERO-AUXIN (FOR COMPARISON WITH *E*. IN *E* AND *F* THE ARROW INDICATES THE DIRECTION OF THE GRAVITATIONAL PULL).

Only those embryos from which the stem apex had been removed failed to produce green plants, but their roots continued growth in the sucrose medium for many weeks. Plants arising from the isolated stem apex were dwarfed; each consisted of a main stem and one tiller, and in one the main axis bore an ear on a stem about four inches high, with six leaves. The progress towards flowering made by each plant during 84 days from the end of vernalization is shown in the table; no further observations were made. Comparison with plants grown from embryos vernalized for two weeks makes it clear that vernalization treatment has accelerated flowering but that the process was less effective than in the case of complete embryos.

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[1] Gregory, F. G., and Purvis, O. N., NATURE, 138, 249 (1936).
[2] Gregory, F. G., and Purvis, O. N., *Ann. Bot.*, N.S. (2), 237 (1938).
[3] Gregory, F. G., and de Ropp, R. S., NATURE, 142, 481 (1938).
[4] Konovalov, I. N., *C. R. Acad. Sci.*, *U.R.S.S.*, 16, 381 (1937).

Permeability of Insect Cuticle

ONE of the major problems in research on insecticidal action concerns the correlation of the toxicity of an insecticide with its chemical and physical properties. Very little progress has hitherto been made when relatively non-toxic carriers have been used. This is mainly due to the fact that too little physiological significance has been attached to the mode of action of the carriers in relation to the toxic principle under investigation.

A study of the toxicities of various constituents of heavy naphtha to the nymphal and adult stages of the bed-bug, *Cimex lectularius*, L., has shown that the toxicity of unsaturated compounds, such as indene, may be materially increased by the addition of non-toxic mixtures of paraffins and cycloparaffins. The assumption that the unsaturated compound was assisted through the cuticle by the more apolar substances present in heavy naphtha led to an investigation of the general physiology and permeability of the insect cuticle. The results show that feebly dissociating compounds of high dielectric constant penetrate the cuticle much more readily in the presence of relatively apolar substances of low dielectric constant, the main region of induced penetration being at the cuticle-hæmolymph interface. This generalization applies both to fumigant and contact action, and may be conveniently illustrated by a model experiment, using as test insects, larvæ of the blowfly, *Calliphora erythrocephala*, Meig.

When a larva is immersed in ethyl alcohol, penetration through the cuticle and tracheal system takes place very slowly, and the insect generally remains active for at least an hour. The effect of paraffins of the kerosene type is even less pronounced, and loss of reaction to a mechanical stimulus may take two hours or more. With a mixture of ethyl alcohol and paraffins, penetration of the alcohol is so rapid that the insect dies within a few seconds, swells perceptibly, and eventually bursts within four to six

minutes. A peculiar swirling effect is noticeable in the region of the cuticle, which is due to the passage of water from the insect. This results in the paraffins being thrown out of solution in the immediate vicinity of the insect, and finally leads to a partial separation of the two components throughout the whole volume of the liquid, the degree of separation depending on their relative proportions in the mixture. Mechanical blockage of the spiracles does not materially affect the nature of the results.

The mechanism of penetration has been studied for the cuticles of several species of insects, and an account of this work, together with various insecticidal applications, will be published in due course.

There are two primary layers in the insect cuticle: an inner chitin layer, which consists essentially of a mixture of chitin and protein, and a thin outer lipoid layer. The present work has shown that this outer layer is relatively impermeable to polar compounds such as ethyl alcohol and acetic acid. The chitinous layer, however, is relatively permeable to both polar and apolar compounds, depending on the type of compound and the particular nature of the cuticle. The permeability of the lipoid layer to polar compounds is greatly increased by the presence of apolar substances. Thus, when a mixture of ethyl alcohol and paraffins is applied to the cuticle, the polar compound will penetrate the outer lipoid layer and then diffuse into the insect through the chitinous layer, the rate and extent of this diffusion being more pronounced than the diffusion of water in the reverse direction. In experiments on Calliphora larvæ, the insects burst before equilibrium was attained. With any particular mixture, the diffusion is governed by mutual solubilities and the pathological changes occurring in the various tissues. The permeability of the cuticle as a whole to polar compounds is increased in *both* directions by the presence of apolar substances. This increase is more pronounced in the direction lipoid layer – chitin layer, than in the opposite direction.

The relation between polarity and induced penetration of one or more substances has been worked out for a large number of compounds, and applies generally to polar substances of feebly dissociating properties, such as alcohols, fatty acids, phenols, nitrogen heterocyclic bases, ammonia, and hydrogen cyanide. Induced penetration appears to be negligible for such strongly dissociating compounds as neutral salts and mineral acids.

The results obtained are in agreement with the work of Alexandrov[1] and Morozov[2] on the permeability of the insect cuticle to various substances acting *singly*. The present work shows a close analogy with the work of Yonge[3] on the permeability of the integument lining the foregut of the decapod crustacean Homarus. So far as can be ascertained, no mechanism for induced penetration has previously been suggested. Fulton and Howard[4] have shown by injection methods that the toxicity of derris inside the insect may vary with the nature of the oil carrier used. This may be correlated with Yonge's suggestion that the permeability of the integument in the Crustacea shows a close resemblance to the permeability of the membrane of the living cell.

Bliss[5] has recently discussed the action of two poisons jointly, and has devised a classification based on relative toxicities of mixtures determined at several dosages. The present work shows that the carriers of the poisons cannot be neglected and that each constituent of a mixture may contribute to the toxicity of the whole even though it may, by itself, have no obvious toxic effect.

This statement is based on work begun under the ægis of the Medical Research Council Bed-bug Committee. Its extension is being carried out by means of a grant made to the Imperial College by the Department of Scientific and Industrial Research. I am especially indebted to Dr. N. F. Sarsfield for his assistance on the chemical side of the work.

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Feb. 28.

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Chronological Sex-Ratios in Drosophila

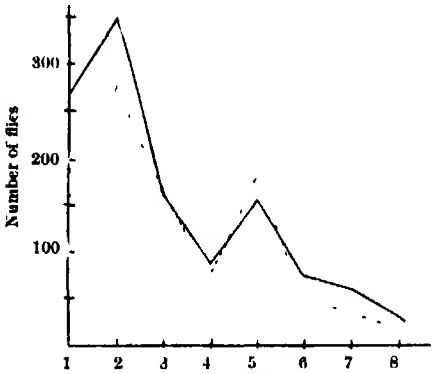
Analysis of the results of observations on *Drosophila melanogaster* involving several thousands of flies substantiated previous observations in connexion with the daily variation in emerging frequency of males and females respectively of the criss-cross generation involving the sex-linked genes *y* and *w*.

Generally, cultures in which the parents were kept for forty-eight hours yielded mostly females on the first and second days of emerging. But on the fourth day of emerging the sexes evened up in numbers and on the fifth day the males outnumbered the females, the sex-ratio dropping below 50 per cent in favour of the males. The respective percentages of the total of females emerged for the first and the following seven or eight days (that is, until the culture is exhausted) were found to be approximately 30; 23; 15; 10·3; 12; 6·4; 0·5; 2; etc. The corresponding percentages of the total of males emerging were 15·7; 18·5; 15·7; 13; 24; 8·1; 2·8; 2·2; etc. (The chronological female percentages (sex-ratios) were: 68; 56; 51·5; 49·4; 36·1; 46·9; 18·2; etc.)

From these percentages it will be seen that 53 per cent of all the females and only 34 per cent of all the males emerged during the first two days. Also it will be seen that the highest percentage, namely, 24 per cent, of all males was realized on the fifth day of emerging, when the males outnumber the females. The second highest daily count of males was obtained on the second day of emerging, namely, 18·5 per cent of the total number of males. After the fifth day of emerging there was a relatively sharp decline in the number of flies emerging, reaching its lowest point on the seventh day. On the eighth day a slight arrest in this decrease was seen. From the fourth to the seventh day the males outnumbered the females. The female figures also showed a slight rise in numbers emerging on the fifth day, while an arrest in decrease seemed to occur on the eighth day of emerging.

Observations on similar lines were made on the mutant stock yellow body colour (*y*), white eyes (*w*) (see accompanying illustration). The daily percentages of the totals of emerged females and males respectively were: 22·5; 29·1; 13·6; 7·2; 13·8;

6·2; 5·0; 2·5; etc., and 16·8; 28·8; 17·2; 7·7; 18·6; 5·0; 3·7; 1·7; etc. Here the female curve also showed a high peak on the second day and another but slightly lower peak on the fifth day of emerging. This fifth day female peak was much more pronounced than that of the criss-cross generation mentioned above. The difference between the number of females and males for the fifth day was consequently not so large as in the case of the criss-cross generation.



Consecutive days of emerging
D. melanogaster (*y-w* stock)
—— ♀♀, - - - - ♂♂, $n = 2143$

Data treated on similar lines and obtained from observations on *Drosophila melanogaster* (wild) and *Drosophila simulans* (wild) showed a pronounced second day peak for both sexes but no fifth day peak. Hereafter there was an unarrested decline. The females were in the majority, more or less to the same degree for every day of emerging. The daily percentages of the total of females and males respectively for *Drosophila melanogaster* were: 28·7; 40·9; 19·5; 9·2; 1·1; 0·27; 0·27; and 22·8; 35·7; 26·0; 12·5; 0·6; 0·3; etc. The corresponding percentages for *Drosophila simulans* were: 18·6; 32·3; 15·7; 13·2; 8·4, 5·7, 2·8; 1·9; etc., and 11·4; 35·8; 20·0; 14·3; 8·6; 3·9; 2·6; 2·6; etc.

It is important to note that especially for the criss-cross generations involving the sex-linked genes *y* and *w*, and probably also other sex-linked genes, the sex-ratio may be inherently different from the first to the last day of emerging.

The percentage of females for the consecutive days of emerging of the criss-cross generation were: 68; 58; 51·5; 49·4; 36·1; 46·9; 18·7; 55·1; etc., the average being approximately 51·6.

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Chromosome Numbers in *Sclerostachya fusca*

Sclerostachya fusca A. Camus (*Saccharum fuscum* Roxb.) is a grass closely related to *Saccharum spontaneum* and similar to it in habit. It is distinguished from Saccharum by its rachis being tough instead of fragile and by its pedicelled spikelets being female instead of hermaphrodite. (The sessile spikelets in both are hermaphrodite.)

This grass grows in association with *Saccharum spontaneum* in Assam and Orissa. I collected several clones from both these localities in 1937. The peasants use it extensively for roofing and making framework for their mud houses, as well as for fencing. It goes by the names of *yekkada* and *ikra* in these provinces.

The Orissa form proved to have 48 chromosomes, and the Assam form, which was of larger habit, had 96 chromosomes.

Most of the Andropogoneæ, including *Saccharum officinarum*, have 10 as their basic number. Exceptions to this are Miscanthus with 36 chromosomes and the dibasic *Saccharum spontaneum* in which forms with $x = 6$ and $x = 10$ have been found.

The doubling within the species is analogous to the condition of *Saccharum spontaneum* with its west-to-east transition from 48 to 112 chromosomes[1]. The discovery of another genus, more closely related to Saccharum than Miscanthus, with the basic number of 6, makes it easier to understand the origin of the dibasic cultivated sugar canes.

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[1] Janaki-Ammal, E. K., "Triplo-polyploidy in *Saccharum spontaneum* L.", *Current Sci.*, 8, 74–76 (1939).

Amœba lescheri (= *Chaos lescheri*): a New Species of Amœba

EARLY in 1938 I discovered a new species of Chaos (better known as Amœba in Great Britain) which I propose to name *Chaos lescheri* = *Amœba lescheri*, to honour the memory of Mary Adela Lescher, founder of Notre Dame College, Glasgow. A full account of the life-history of this amœba will appear in the *Quarterly Journal of Microscopical Science*. The amœbæ of the genus Chaos are large and form pseudopodia that are sub-cylindrical, blunt and filled with granular endoplasm throughout. Conspicuous longitudinal ridges and grooves are characteristic of the ectoplasm. *Amœba lescheri* is readily distinguished from the other species of Chaos by its crystals, which are square prisms (maximum size 2 μ). Outsized spherical individuals attain a diameter of 525 μ, creeping individuals a length of 600 μ. The average for the former is 350 μ and for the latter 400–500 μ.

Translucency in amœbæ is a factor of age and physiological condition, depending to a large extent on the cytoplasmic inclusions. Having regard to these considerations, *Amœba lescheri* is more translucent, as it is also slightly smaller than *A. proteus* Y[1]. The shapes assumed by the contrasting amœbæ also differ, more of the bulk of the cytoplasm being concentrated in the pseudopodia of *A. lescheri*. Normally there is present one nucleus, discoid in shape. Alternate aspects of the nucleus, 'plan and elevation', are presented to the observer as the nucleus is subjected to the streaming movements of the endoplasm. Frequently the nucleus has the appearance of a biconcave lens. Since it normally lies in the peripheral endoplasm it is quickly found in a microscopical preparation of the living animal. The chromatin is distributed on an achromatic network and takes the form of regularly arranged blocks under the nuclear membrane distinct from, and slightly separated from,

the rest of the network where the chromatin is not so regularly distributed.

There is one contractile vacuole (42 μ) which empties very deliberately after having moved to the posterior end. Nutritive spheres vary in size from 1 μ to 7 μ, depending on the age of the amœba, which feeds voraciously on ciliates, flagellates and rotifers. Excreta, including crystals, are gathered into a large vacuole in which a violent commotion is set up, the contents being shot explosively out of the vacuole.

A. lescheri has a marked tendency to send its pseudopodia in all directions even when more or less imprisoned under a cover slip. After having gripped the substratum and moved definitely in one direction on one, two or three pseudopodia, it loosens itself by forming radial pseudopodia and floats about. It may later return to the creeping position.

Fission of the cytoplasm may easily be observed. Spherical individuals are often binucleate. Two daughter sets of pseudopodia formed on one such floating binucleate individual indicate the onset of fission. The two daughter amœbæ use the floating debris to separate themselves as they float away. There is no thin connecting strand of protoplasm—the break is clean-cut Under favourable conditions of environment *A lescheri* divides once in twenty-four hours and is a good subject for 'pure-line' experiments.

One of us (Sr. C.) has investigated the cytology of the nucleus. In contrast to *A. proteus* Y. the number of nuclei never exceeds two The average diameter is 42 μ. There is great diversity in the size of the chromatin blocks where the chromatin is more voluminous and not so immeshed in achromatic network as in *A. proteus* Y. Division in the nucleus is *amitotic*.

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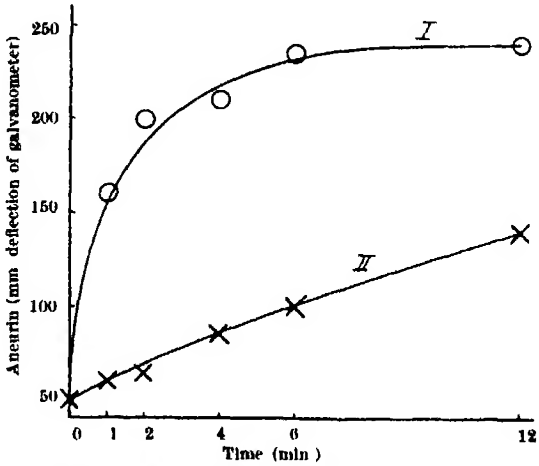
[1] Carter, Lucy A., *Proc Roy. Phys Soc. Edin.*, **20** (1919)

Cause of the 'Activation' of the Carboxylase System by Free Aneurin

About two years ago, Ochoa[1] made the remarkable discovery that decarboxylation of pyruvic acid by alkaline washed yeast, Mg^{++}-ions and cocarboxylase is stimulated by pure aneurin and by some derivatives of the pyrimidine part of the aneurin molecule. We have now discovered the mechanism of this stimulating action by performing some aneurin and cocarboxylase determinations by means of the thiochrome method[2]. All experiments have been carried out with baker's yeast, dried at 25° C., supplied by Distillers Co., Ltd., Epsom, with which aneurin exhibits a strong effect as compared to many other yeasts[3].

When aneurin and cocarboxylase are determined about one minute after adding cocarboxylase to a suspension of alkaline washed yeast in phosphate buffer, *p*H 6·2, a considerable part of the quantity of cocarboxylase added appears to have been converted into aneurin already. The amount of aneurin still increases rapidly during the first minutes after incubating the suspension in a bath at 28° C. From these findings some conclusions could be drawn: (1) a phosphatase, very active at *p*H 6·2, is present in alkaline washed yeast; (2) no experiment performed with this yeast, to which cocarboxylase was added, has been carried out in the absence of free aneurin; (3) the amount of cocarboxylase really acting is always much smaller than the amount added and supposed to act. These results led us to the hypothesis that Ochoa's aneurin effect might be caused by the inhibition of the phosphatase action by aneurin, namely, one of the reaction products of cocarboxylase hydrolysis. So the aneurin would not actually stimulate the carboxylase system, but only inhibit a reaction destroying cocarboxylase.

The following experiment has fully confirmed this hypothesis. As we met with some difficulties concerning the thiochrome method, when it was applied to a very large amount of aneurin in proportion to the amount of cocarboxylase present, this experiment was carried out with 2-methyl-4-aminopyrimidyl-5-methylaminodihydrochloride instead of aneurin.



Formation of aneurin from cocarboxylase by alkaline washed yeast, suspended in phosphate buffer, *p*H 6·2.
Curve I in the absence of the pyrimidine part of the aneurin molecule, Curve II in the presence of the pyrimidine part of the aneurin molecule.

A sample of dried yeast was washed with sec. sodium phosphate in the usual way for a manometric cocarboxylase determination. The suspension in phosphate buffer, *p*H 6·2, was divided into two equal parts. One of these parts was supplemented with an amount of 2-methyl-4-aminopyrimidyl-5-methylaminodihydrochloride, giving maximal 'activation' (200 γ per 100 mgm. yeast), and both parts were allowed to react with cocarboxylase (5 γ per 100 mgm. yeast). Aneurin and cocarboxylase were determined at the times plotted in the accompanying graph. These curves, showing the velocity with which aneurin is formed, clearly demonstrate the inhibiting effect of the pyrimidine derivative on the phosphatase action. The curves showing the velocity of the decrease of the quantity of cocarboxylase are exactly the mirror-images of the curves of the accompanying graph; they are omitted to save space.

We believe we can explain all observations concerning the influence of aneurin on the carboxylase system from the point of view developed here; for example, the different sensitivity to aneurin of different kinds of washed yeast[3] (different amounts of phosphatase); the influence of the temperature

of the phosphate solution used for washing the yeast[3] (destruction of phosphatase at higher temperature); Lipmann's observation[4], fully confirmed in this laboratory by Mr. Eitje and Mr. Hiegentlich, that aneurin is without any effect, when it is added to the yeast suspension some minutes after the addition of cocarboxylase (cocarboxylase destroyed already before the inhibition of phosphatase by aneurin); no stimulating effect of aneurin observable with Weil-Malherbe's purified carboxylase[5] (absence of phosphatase)

We wish to thank Prof B C. P Jansen for his kind interest in our work

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Feb 3.

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[3] Westenbrink, H. G K., *Enzymologia*, in the press
[4] Lipmann, F, *Enzymologia*, 7, 142 (1939)
[5] Weil-Malherbe, H, *Biochem J*, 33, 1997 (1939)

Chalk Landscape

GEOLOGISTS used to ask themselves a riddle: How did the rounded outlines of the chalk denes and downs come to show the forms characteristic of sculpture by streams, since water runs straight through the chalk and does not form streams upon it? The acceptable answer to the riddle used to be that long ago the chalk below the surface was made impermeable summer and winter by frost, and that in the spring the snows of winter rushed off the frozen surface in torrents. Weather conditions last winter in our part of Wiltshire illustrated this strikingly in a way which the oldest inhabitant does not remember to have seen before. My house is in a dene in the chalk sloping gently to the Kennet for nearly two miles, with downs on each side. It will be remembered that there was first sharp frost with heavy snow-falls, then a few days thaw, and then again sharp and prolonged frost. The effect of this, no doubt, was to seal the chalk with a layer of absorbed and frozen water. During the second and prolonged frost there was the now celebrated incessant deposition of dew in the form of ice, and of snow, making a big accumulation of water on the top of the frozen layer. Then came the final thaw. With it, for the first time within living memory, a stream appeared and flowed briskly down the dene, doing a little water sculpture on its way and leaving some tiny deposits which will make good Combe rock in the future.

How rare such an occurrence is under modern conditions is shown by the fact that my house is built in the very bottom of the dene. So it gave difficulties to the stream, out of which it could find no better way than to run straight through the house from the front door to the back.

During the second great frost the young trees were so weighted with solid ice that the tops of many were bent to the ground and old trees had great boughs broken—a strange sight but one not unseen before, for a student points out to me these passages in a letter of Erasmus:

"Deinde grando, tum et pluvia, quae simul atque terram arboremve contigit protinus in glaciem concreta est Vidisses arbores glacie vestitas adeoque pressas ut aliae summo cacumine imum solum contingerent, aliae ramis lacerae. Jurabant nobis e rusticis homines natu grandes se simile nihil unquam in vita vidisse antea."

Lockeridge KENNET OF THE DENE.
March 1.

Points from Foregoing Letters

A RECENTLY published account by H. F. Bain describes the isolation from unsterilized roots of *Vaccinium macrocarpon* growing in America of a mycorrhizal fungus specifically distinct from the *Phoma radicis* isolated by Ternetz from sterilized roots of native Swiss species of Vaccinium in 1907. In view of this discrepancy, M. C. Rayner and I. Levisohn have investigated British material of *Vaccinium Oxycoccus*, and now record that the fungus isolated by them from sterilized roots of this species agrees in every particular with that isolated by Ternetz.

O. N. Purvis has successfully vernalized fragments of winter rye embryos consisting of the stem apex and one leaf initial only, by culturing on a suitable medium for six weeks at 1° C. The response was less than that of whole embryos to similar treatment.

The toxicity of poisons used in insecticides depends primarily on the physico-chemical relations of the toxic principle and the carrier. H. Hurst finds that feebly dissociating compounds of high dielectric constant penetrate the cuticle of insects more readily in the presence of relatively apolar substances of low dielectric constant, the main region of induced penetration being at the cuticle-hæmolymph interface.

Data obtained by G. Eloff in connexion with daily counts of offspring from Drosophila cultures in which parents were left for forty-eight hours, pointed in the case of the criss-cross generation to a high emerging frequency on the fifth day of counting, especially accentuated in the case of the males. In the case of pure yellow-white cultures of *D. melanogaster* the females also showed a strong fifth day peak. The phenomenon, which is probably associated with lowered viability, was absent in the case of wild cultures of *D. melanogaster* and *D. simulans*.

A new species of Amœba of the genus Chaos has been isolated and cultivated and is briefly described by M. Taylor and C. Hayes. *Amœba lescheri* is slightly smaller than *Amœba proteus* Y, which it resembles in many ways. The nucleus, which is discoid and situated in the peripheral endoplasm, divides amitotically. Fission of the cytoplasm can take place while the amœba floats and occurs once a day.

H. G. K. Westenbrink and D. A. van Dorp have investigated the cause of the apparent activation of the carboxylase system by free aneurin. In their opinion it is caused by the inhibitory effect of aneurin on the hydrolysis of cocarboxylase by phosphatase, present in the alkaline washed yeast.

RESEARCH ITEMS

Rostro-Carinate Stone Implement from Rhodesia

IMPLEMENT-bearing talus on the lower slopes of the Gwelo Kopje, Southern Rhodesia, known for some years to students of Rhodesian prehistory as the source of a sequence of stone implements in which flake implements are associated with *coups de poing*, has now produced an undoubted rostro-carinate which is described by Neville Jones (*Trans. Rhodesia Sci. Assoc.*, **37**; 1939). The implement is of special interest as it is the best example of the form as yet found in Southern Rhodesia, and its occurrence in a deposit which contains no evidence of fracture from natural causes after deposition gives added weight to the claim for the human manufacture of this type of implement. It is the only unmistakable rostro-carinate found at Gwelo. The form is characteristic in that it is fairly symmetrical and broadest at the posterior end, from which it tapers to a sharp point, which imparts to it a beak-like appearance. The ventral surface is unflaked and presents the natural weathering. Parallel with this is the small dorsal platform, originally triangular, from the apex of which the keel begins and extends to the top of the 'beak'. The sharp-edged keel is strongly curved in elevation, fairly true to the median line and is slightly sinuous in plan It is formed by the removal of a wide flake on each side. The weight is 1 lb. 6 oz Though there is no evidence of comparative age, it may be claimed, from analogous finds at Hope Fountain, to be a tool of early type.

Studies of American Cities and States

A STUDY of American cities and States by methods which have proved valuable in the study of individual persons has been published by E. L. Thorndike (*Annals N.Y. Acad. Sci.*, **39**, 213–298; 1939). Variations and correlations in institutions, activities and the personal qualities of the residents have been obtained for each city in the United States having a population of more than 30,000 in 1930, but excluding the cities of more than 500,000, except Milwaukee, and the three resort cities, Atlantic City, Miami and St. Petersburg The 296 different items examined covered population and growth, value of public property, literacy, expenditure on public services, sales and prices, rents, salaries, mortality figures and vital statistics, occupational data, membership of institutions, etc. The data show very great variation in important features of life and welfare, and for each city and State composite scores have been computed which may be used as indexes, respectively, of the general goodness of life for good people in the community in question, the *per capita* income of its residents and their personal qualities of intelligence, morality and care for their families.

Growth and Feeding of Young Herring

S. M. Marshall, A. G. Nicholls and A. P. Orr have continued their studies on the growth and feeding of young herring in the Clyde (*J. Marine Biol. Assoc.*, **23**, 1939). The last paper dealt with growth from spawning to metamorphosis; the present paper gives the results of an attempt to continue the work from metamorphosis up to the formation of the first winter ring. Two distinct groups were met with. The first, obtained during July 1936–May 1937, were caught inshore; the second, of which only a few catches were taken, in 1937 and 1938, were caught offshore. The second group is shown to be of the same origin as those discussed in the previous paper. Details are given of counts of vertebræ and lengths for race determination, size and growth, weight, chemical composition and food. A series of hauls made over a night showed that the herrings were most abundant inshore at dusk and dawn and contained most food during 7–11 p.m. The food was examined throughout the year and compared with the plankton hauls. Copepods, as is usually found, formed the main diet, but other organisms were at times plentiful, coinciding with their abundance in the plankton. Thus when cirripede larvæ were common in the plankton, the stomachs were full of them; this was also the case with Cyphonautes. With Calanus it was different, this copepod being frequently common in the gut and quite absent from the accompanying plankton hauls, which suggests that the herring had been feeding offshore before they were caught, although the presence of typical littoral plankton shows that they fed inshore as well. In general the results of the food investigation agree with those of other workers.

Amphibian Anatomy

VARIOUS features of the skeletal elements of the skull, hyoid apparatus and vertebral column of the Amphibia have been employed for the purpose of systematic diagnosis. In a recent paper, L. S. Ramaswami (*Proc Ind. Acad. Sci.*, **10**; 1939) has critically examined these as recorded in previous literature and in the light of his own considerable experience in five genera of anurous Amphibia. He has already published a series of detailed observations on this subject (1932–37), and the present paper serves in some respects as a summary of these. A number of criteria previously used are shown to be of no use, and the author concludes with a detailed list of the characters that can be used in the Ranidæ, Rhaophoridæ (Polypedatidæ), Microhylidæ, Bufonidæ and Pelobatidæ.

A New Species of Rose

THE expedition of Captain F. Kingdon Ward to Tibet in 1924 resulted in the introduction of several rose species to European horticulture. One of these, No. 6101, was provisionally named *Rosa Sweginzowii* var. *inermis*, but Mr. B. O. Mulligan, who has examined several shrubs now in cultivation in England, considers it to be a new species, which he has named *R. Wardii* (*J. Roy. Hort. Soc.*, **65**, Pt. 2; February 1940). A full diagnosis is given. The rose is attractive from a garden point of view, bearing white flowers with striking red centres.

Filterable Viruses

A USEFUL review of the filterable viruses of animals and plants has recently been published by L. J. Davis (*Proc. Rhodesia Sci. Assoc.*, **37**; September 1939). Consideration is given to modern findings under the various headings of filtration, microscopy, possible culture, pathology and host relations, chemical composition, and resistance to inhibiting

agents. Perhaps the most interesting section, however, is that on the nature of viruses. The question "Are they Animal?" is dismissed somewhat summarily, and the evidence as to their vegetable or mineral nature leads to the general conclusion that "viruses, or at least some of them, while manifesting the properties of living matter may actually occur in a form never before known to be compatible with life, a kind of non-cellular life"

Bacteriophage and Plant Lysins

THE origin of the mysterious bacteriophage, the transmissible agent which dissolves living bacteria, has never been accounted for. It was discovered by Twort and arises spontaneously in cultures of bacteria under certain conditions D'Herelle maintains that it is a living ultra-microscopic agent, others believe that it is a chemical agent, capable of regeneration, analogous to a plant virus In a paper communicated to the American Association for the Advancement of Science at Columbus, Ohio, in December last, Roy C. Thomas suggests a possible mode of origin He finds that a non-specific lysin or 'dissolving' agent is found in many plants. It is inactivated by heating to 56° C. for thirty minutes, and has much the same action upon bacteria that bacteriophage has. When this lysin comes into contact with bacteria susceptible to its action, a change occurs resulting in the formation of a transmissible lytic principle similar to bacteriophage; it is not inactivated at 60° and only partially at 65°. It is suggested that this is the origin of the bacteriophage, at least in plants. With regard to corn wilt bacteria, with which much work was done, a bacteriophage can be obtained for any strain which does not contain one, and a phage developed for a culture is highly specific for it.

Fluorescence of Diacetyl

KALLE (*Naturwiss.*, 25, 61; 1937) observed that when aqueous diacetyl is irradiated with violet or near ultra-violet light it exhibits a vivid green fluorescence which increases from zero to a constant saturation intensity. Almy, Fuller and Kinzer (*J. Chem. Phys.*, 8, 37; 1940) have shown that this delay is caused by the quenching action of dissolved oxygen which is ultimately consumed. On outgassing, the fluorescence appears immediately in its full intensity. Oxygen and carbon dioxide quench the fluorescence temporarily. They also found that diacetyl vapour exhibits fluorescence. The fluorescence spectra of both are identical with that of acetone excited by 3130 A., but, in contrast to diacetyl, the fluorescence of acetone rises gradually from zero intensity. This is explained by assuming that the fluorescing molecule in both instances is diacetyl. The fluorescence of acetone will then grow in intensity as the concentration of diacetyl in it increases. Further, acetone is excited by 3130 A., which does not affect diacetyl. This is considered due to the formation of diacetyl molecules excited by collisions of the second kind, diacetyl with excited acetone molecules, or by a three-body collision of diacetyl with two combining radicals. The fluorescence spectrum of diacetyl was found insensitive to changes in diacetyl pressure (0·1–50 mm.), temperature (10°–100°), and exciting wave-length (3650–4358 A.). The ratio of intensity of fluorescence to light absorbed is independent of the pressure, and the intensity is linearly proportional to the exciting intensity at constant pressure. The quenching of fluorescence by oxygen follows the Stern-Volmer law over the range in which the fluorescence falls to 20 per cent of the initial intensity; at higher pressures the intensity falls more rapidly than is expected The life-time of the fluorescing molecule is estimated as 10^{-3} sec.

Insulation Stresses in Transformers

A PAPER read by J. L. Thomas to the Institution of Electrical Engineers on February 22 discusses the stresses in the insulation of transformers, with special reference to surges and electrostatic shielding. The normal working voltage per turn on even the largest transformer is not likely to exceed about 100 volts. Hence the amount of inter-turn insulation required for normal working conditions is ample when compared with the minimum considered necessary mechanically. The established standards of high-voltage tests, which originally had an empirical origin, have resulted in major insulation proving itself generally adequate by satisfactory service records even in districts subject to severe lightning At the present time, the principal application of 'non-resonating' shielding is in connexion with transformers for exceptionally high voltages of 220 kv. and above. The mathematical theory shows that the effect of the shielding is to reduce the space harmonics, and in particular the higher harmonics, and so to reduce the peak voltage gradients. Oscillograms are shown of a large number of tests on the effects of shielding. In all cases the shields have been shown to effect a substantial improvement. Results are given of tests on a three-phase 88 kv.–8,000 kva. transformer in oil The large effects produced by 'chopped' impulses on inter-coil voltage transformer windings with and without shields are shown. The author shows that shielded winding makes possible an economical design in which it can be ensured that inter-cell failure under impulse conditions will not occur before major insulation breakdown.

Meteor Observations from India

MOHD. A. R. KHAN, Begumpet, Deccan, has sent an account of his observations of meteors in 1939. Altogether he recorded the paths of 1,233 meteors and these included members of some of the major showers. The maximum display of Orionids was attained on October 19, a total of eight being observed between 21h. 30m. and 22h. 30m.; on October 17 only two were seen and on October 18 five. Two of the latter were very bright, with magnitudes – 1 and – 2·5. On November 13, 27 meteors were observed between 22h. and 23h. but only 5 of these were Leonids. On November 14, out of 13 meteors observed from 20h. 45m. to 21h. 30m., there was one Leonid, and on the following night during watches extending over 1h. 15m., out of 8 meteors there were 5 Leonids. On November 16, during a watch of 45m., a total of 30 meteors was observed, 5 of which were Leonids. On December 12, in a watch of 2h. 10m., a total of 74 meteors was seen, 15 of which were Geminids. Although most of these were faint, as is usual with this shower, there were three bright meteors, of magnitudes 1, 0, and – 3 respectively. On December 14 watch was maintained for 1h. 20m., and 10 Geminids were observed, 4 of which were fairly bright. Careful watches were kept on October 9 at different times for Giacobinids, but none was seen; on the following night clouds rendered observations useless.

INDIAN SCIENCE CONGRESS ASSOCIATION

Madras Meeting

The Deccan Traps: An Episode of the Tertiary Era

At the dawn of the Tertiary era, vast outpourings of basaltic lavas covered immense regions in the north-western United States, in the old Thulean province which extended from Greenland to Scotland and Ireland, and in the Deccan. In estimating the exact geological age of these lavas, much depends on the interpretation of the fossils (chiefly plants) from interbedded sedimentary deposits. Recent work on the interbasaltic flora of the Hebrides was summarized by Sir Albert Seward in his presidential address to the British Association at Dundee in 1939, and now Prof. B. Sahni, presiding at the twenty-seventh Indian Science Congress held in Madras during January 2–8, has discussed the Inter-Trappean flora of the Deccan.

Fissure eruptions, Prof. Sahni thinks, may once have spread sheets of lava over some half million square miles, and even after continuous erosion for millions of years the Deccan Traps still cover an area of 200,000 square miles. Thickest along the west coast (six to ten thousand feet), their abrupt ending gives no measure of their extension over a tract of land that foundered into the Arabian Sea.

The flora is known mainly from sediments in the Nagpur and Chhindwara districts of the Central Provinces, occurring between some of the lowest and oldest flows in the whole series; the plant-bearing beds at Rajahmundry on the east coast are also low in the series. No Inter-Trappean beds have yet been discovered in the middle part, and the lava-flows may have issued in such rapid succession that there was no time for extensive colonization or deposition of sediments. (The plant-bearing beds of western Scotland are also found between some of the basal flows.) At Bombay Island the upper members of the Deccan Traps include sedimentary beds yielding a pigmy frog and other organic remains, but no plants have yet been recorded. The highest Traps are in places covered by marine beds of known Eocene age, which fixes an upper limit for the age of the series.

The view that the Traps were poured out during the Cretaceous is not supported by the fossils. One of the most conclusive single pieces of evidence is the occurrence of fruits belonging to the brackish-water stemless palm Nipa, a plant characteristic of Eocene beds at many points near the shores of the former Tethys Sea, for example, in the London and Paris basins, in Poland, southern Russia and Egypt. The palms, known from numerous fruits as well as from abundant petrified wood, dominated the Inter-Trappean flora; although this family arose in the Cretaceous period, it did not become prominent until after the Tertiary era had begun. The abundant charophyte fruits support an early Tertiary age, while the water-ferns, unknown from pre-Tertiary rocks, are represented by a beautifully preserved Azolla.

Numerous other elements in the flora are of botanical rather than geological importance; they include fungi belonging to the Perisporiaceae and Sordariaceae, many types of spores, and various dicotyledonous fruits.

Galactic Dynamics

For his presidential address in the Section of Mathematics, Prof. A. C. Banerji chose as his subject "The Development of Galactic Dynamics and Some Allied Problems". Under this heading was considered a wide selection of the mathematical researches that have been made into the effects of rotation on gravitating masses.

The survey began with the classical researches concerning the stability of spheroids and ellipsoids of uniform density, and went on to a discussion of the pear-shaped figure, while the later work of Jeans on the analogous behaviour when the mass is compressible was also touched upon. The possibility of extending the treatment to the case of a fluid under more general physical conditions led to the recent investigations by Milne, Bhatnagar and others on the distortions that a fairly small rotation would cause in polytrophic distributions, and in particular Chandrasekhar's results for double stars. The work by Eddington in which any spherical distribution can be discussed by means of a variable polytropic index was considered next and reference was made to the special feature of this method, that many properties are intermediate between the corresponding properties of the two spheres whose polytropic indexes are the extreme values of the variable polytropic index.

Turning to the problem of rotating nebulæ of galactic dimensions, the discussion was commenced by describing Hubble's classification of the various observed types. Before proceeding to the problem presented by the spiral arms of nebulæ, the difficulties found by Jeans concerning the impossibility of the formation of stars in an equilibrium configuration of a nebula were brought forward. As for the theories of the spiral forms of the arms, Jeans's point-mass model was considered first to demonstrate the difficulty that the existence of stars is incompatible with the necessary gaseous structure of the nebulæ. The results obtained by E. W. Brown that spiral arms could persist for long periods only under very artificial systems of forces were quoted next, and in the same category were taken the more speculative suggestions of Vogt and Lambrecht postulating cosmical repulsion in the galaxies. Proceeding to our own galaxy, it was suggested that the differential rotation may be an indication of instability in the outer regions.

Arising out of the question of the formation of spiral arms, Prof. Banerji said that it is first necessary to decide whether in Newton's second law the impressed force is proportional to the mass times the acceleration *or* to the rate of change of momentum, and various opinions on this point were cited. The existence of interstellar matter and its possible dynamical effects completed the account given of galactic problems.

In conclusion, Prof. Banerji referred to the recent advances in the theory of the origin of the solar system. It was explained how the former difficulties relating to angular momentum had been resolved by Lyttleton, starting with the hypothesis that the planets were formed from a companion star to the sun during an encounter with an intruding star.

The effects of tidal friction in bringing about some of the detailed features of the solar system were briefly discussed, as, for example, the suggestion that the slow rotation of Venus can be explained by supposing that Mercury was formerly a satellite of this planet, and that the retrograde satellite of Neptune arose as a result of an encounter between two direct satellites, of which one escaped as an independent small planet (Pluto), and the other was diverted into a retrograde orbit.

MAGNETIC STUDIES OF AROMATIC MOLECULES

Prof. K. S. Krishnan delivered the presidential address to the Section of Physics, taking as his subject "The Diamagnetism of the Mobile Electrons in Aromatic Molecules".

Prof. Krishnan pointed out that our knowledge of aromatic molecules, particularly benzene, has been extended very considerably during the last few years by the quantum-mechanical treatment of the linkages and valency electrons and by the experimental determination of the symmetry and normal modes of vibration by means of infra-red and Raman spectra. It is now known that in benzene one electron of each carbon atom is mobile and can move from carbon to carbon, conferring on the molecule magnetic properties somewhat similar to those of free electrons in metals.

Outlines were given of the theories of paramagnetism of an electron gas and of diamagnetism of a free-electron gas; and the experimental data on graphite were reviewed with special reference to the temperature variation of magnetic anisotropy. These data verify Landau's view that quantization of the motion of free electrons in the magnetic field leads to a balancing between the diamagnetic and paramagnetic contributions, and that the temperature-independent diamagnetism of the free-electron gas is one third of its paramagnetism.

Mobile electrons in aromatic molecules are free to move anywhere in the ring; this is the same as postulating resonance between canonical structures, five of which are required for benzene, whilst for naphthalene 42 and for anthracene (or phenanthrene) 429 are necessary Mobile electrons in aromatic molecules give rise to abnormal diamagnetism in the direction perpendicular to the plane of the ring and, consequently, to large diamagnetic anisotropies. For single crystals of such magnetically anisotropic molecules, if the magnetic constants are known, orientations of the molecules in the crystal lattice can be deduced, or, conversely, if molecular orientations are known from X-ray data, the principal magnetic constants of the molecules can be calculated. This calculation supports the theory when applied to sixteen aromatic molecules, and the contribution of mobile electrons is approximately proportional to the number of benzene rings in the molecule. These mobile electrons also give rise to optical effects, fluorescence and absorption, in both of which it is the component parallel to the molecular plane which is active. Not only are mobile electrons associated with benzene rings, but also with other conjugated ring structures, for example, cyanuric trichloride and phthalocyanine.

The address concluded with a brief consideration of theoretical calculations of the magnitude of diamagnetic anisotropies.

ROLE OF CHEMISTRY IN FORESTRY

Dr. S. Krishna, presiding over the Section of Chemistry, covered a wide range of topics in his address upon the role of chemistry in forestry. His topic is very suitable to current conditions, as it directs attention to the many ways in which Indian sources of supply, of drugs, dyes, tanning material and the raw material for many industries might be drawn upon, with increased income for the country and a diminished demand for imports. The work of the chemist was reviewed in connexion with production, conservation and utilization, but perhaps the main emphasis was placed upon the latter.

Very interesting Indian examples were cited of differences in chemical constitution and of economic importance, which had remained unrecognized by the systematist. In the Kurram valley (North-West Frontier Province) two varieties of *Artemisia maritima* grow side by side, one of which yields nearly 2 per cent of santonin but the other has none; only later was it noted that the young plants of the valuable forms had reddish stems, while the others were green at this stage. Four varieties of *Eucalyptus dives* exist, morphologically indistinguishable, but yielding oils with piperitone content ranging from 5 to 50 per cent. In connexion with seasoning, problems of timber impregnation were discussed, and attention was also directed to the recent Russian experiments using ultra-short waves.

Considerable attention was given to the possibility of increasing forest revenue by greater utilization of minor products. Baluchistan forests, run at a deficit for more than thirty years, have recently become solvent on the sale of Ephedra. Although many minor products would not repay harvesting on a large scale, they may have possibilities if organized on the lines of 'cottage industries'. Amongst minor 'forest' products, grasses and bamboos have supplied most revenue, particularly for the production of the better grades of paper. Another minor product available to prevent present imports is turpentine, now obtained from the oleoresin of *Pinus longifolia*. This is not so rich in pinene content as the turpentine from other species of pines such as *P. excelsa*; when such sources are tapped, they would be available for conversion into camphor, at present wholly imported.

Dr. Krishna advocated the formation of an association to stimulate the cultivation and utilization of medicinal plants in India, in order to promote the utilization of India's very valuable drugs, sources of many of which are found in India's forests.

THE UPPER CRETACEOUS AND LOWER EOCENE

Prof. L. Rama Rao, in his presidential address to the Section of Geology, took as his subject "Recent Advances in our Knowledge of the Upper Cretaceous and Lower Eocene Beds of India, with special reference to the Cretaceous-Eocene Boundary".

During the past few years several geologists, working in various parts of India, have made material contributions to our knowledge of the stratigraphy and palæontology of the uppermost Cretaceous and Lower Eocene rocks of this region. Much new light has thus been thrown upon the position and nature of the Cretaceous-Eocene boundary and upon questions of palæogeography.

The Ranikot beds, long ago recognized as the basal division of the Eocene in Sind, have been shown to be of pre-Ypresian age. They are now known to be much more widely distributed than was formerly supposed, occurring also in the North-West Frontier Province, the Salt Range, Kashmir, Tibet, Burma, and western Iran. In the Samana Range (North-West Frontier Province) the Hangu Shale, with its rich fauna, seems to constitute the lowest fossiliferous horizon of this formation anywhere known; it is separated from Upper Cretaceous deposits by a conformable series of beds which, however, have yielded no fossils. A similar transition from the Cretaceous to the Eocene seems also to exist in Burma and possibly in Tibet.

In the Peninsular area interesting discoveries of fossils have recently been made in beds intercalated in and underlying the Deccan Trap; their study has led to the conclusion that the Trap belongs to the Lower Eocene rather than to the Cretaceous, as formerly supposed. The well-known Infra-Trappean bed of Rajahmundry would appear to lie almost upon the border-line between the Cretaceous and the Eocene. Prof. Rama Rao's own researches have led to the important new discovery of Lower Eocene beds overlying the Cretaceous in the Pondicherry district. Especial reference was made to the study of the fossil algæ of many of the rocks under discussion, as this work is proving of great help in their correlation.

In discussing, next, the geography of early Eocene times, Prof. Rama Rao visualizes, in the west, an arm of the ancestral Indian Ocean stretching northward so as to cover Sind, Baluchistan, parts of the Punjab, the North-West Frontier Province, and Kashmir; and dividing, in the north, into two branches, which extended respectively to Iran and Tibet. A second arm of this sea, situated to the east of India, extended northward into parts of Assam and Burma. Reference was made to the divergent views of various authorities as to whether there was direct communication with the Mediterranean Sea of that period.

In his concluding remarks, Prof. Rama Rao pointed out that the great geographical changes which heralded the incoming of Tertiary times must everywhere have affected the balance of marine life; hence a normally evolving succession of forms may not have persisted even in those parts of the sea where sedimentation was uninterrupted.

GEOGRAPHY IN NATIONAL PLANNING

The Section of Geography and Geodesy was formed on the occasion of the Jubilee meeting at Calcutta in January 1938, when its sessions were attended by a strong delegation from Britain. The president this year of the Section was Dr. S. P. Chatterjee, and in his presidential address he directed attention to the part which should be played by geographical studies in national planning.

A stock-taking of resources on a provincial basis is an essential pre-requisite of any work of national reconstruction, and that there is no country in the world where there is a greater need of a detailed land utilization survey than India. The assertions that in Bengal, which is selected for study as Dr. Chatterjee's native province, the land is deteriorating, soils losing fertility, marshes and lakes increasing in area at the cost of good arable lands, and river-borne sediment failing to build up the land, all require substantiation. The official statistics, skilfully shown in cartographic form, show that only one third of British India (contrasted with nearly half of 'Indian' India) is actually cropped. In Bengal, which in places supports a *rural* population, albeit in a condition very near the starvation level, of a thousand persons per square mile, no less than one quarter of the whole province is classed as fallow and cultivable waste, whilst less than half is actually cropped.

Dr. Chatterjee has clearly appreciated his training both in the French school and in Britain, and has attacked the problem on a regional basis. He gives the preliminary results of a survey carried out in the past two years and suggests a division of Bengal into ten regions As frequently happens, the local cultivators know and appreciate small differences in soil and the local names (mainly based on texture) have been used to divide the new alluvium into ten types the distribution of which is shown on an instructive map.

As Chatterjee says, "since national planning means a conscious effort of man to change his environment in the best national interest, it is rational to be equipped with a thorough and accurate knowledge of the type, historic growth and present distribution of the various factors that go to form our cultural landscape, which is the subject matter of geography", and on this basis he appeals for an All-India organization for conducting a geographical survey.

(*To be continued*)

AIR CIRCULATION OVER INDIA

A MEMOIR of the India Meteorological Department (26, Part 10) by K. R. Ramanathan and K. P. Ramakrishnan, entitled "The General Circulation of the Atmosphere over India and its Neighbourhood", is probably the most complete account that has yet appeared of the average winds and temperatures in the upper atmosphere over India in each month of the year.

The observations of upper wind made with the aid of pilot balloons at observatories, and those of cloud movement, together with the measurements of temperature aloft by sounding balloon made at Agra, Poona and Hyderabad, form the basis of the discussion. Mean isotherms for various levels up to 6 km. were obtained partly from the changes of wind with height, from which the mean magnitudes and directions of the temperature gradients were calculated, and partly from the mean temperatures at the different heights for the three upper air observatories, supplemented in some cases by temperatures measured at Peshawur or Quetta. Although in theory it is sufficient, having obtained a chart of temperature gradient, to have the vertical distribution of temperature at only a single station in order to be able to draw the absolute values of the isotherms, in practice, the computations being only approximate

at every stage, the accuracy of the final picture was increased by having means of temperature at several places.

The results are set out in 74 plates, the mean air movement being taken up to 8 km. The main features of the upper wind and temperature distribution in the different months are discussed and then summarized (pp. 192–207). The most striking feature of the circulation is the regular seasonable movement of the upper wind system, which in the summer half of the year is from south-east to north-west and back, and in the remainder of the year is mainly from north to south and back. The smallness of the month to month movement from December to April or May is taken to signify that cooling and heating of the ground over India by radiation does not greatly modify the circulation, the big changes being caused by the northward penetration and the subsequent retreat of moist air from the southern hemisphere with its attendant rainfall.

Other striking features brought out by this study are the modifying influence of the Himalayas up to a height of 6 km., and the fact that regions of heavy rainfall become regions of high temperature and divergence of air movement above 6 km. The mean winds derived from cloud movement have a much larger northward component than those derived from pilot balloons, which last require absence of cloud so that the balloon can be followed. A true picture of average conditions cannot therefore be obtained from either method alone

ECONOMICS OF WAR-TIME EXPORT TRADE

A VALUABLE broadsheet "Exports in War" issued by Political and Economic Planning (P E P) reviews the question in relation to the economics of war and the principles upon which the export policy of Great Britain should be based. The object of exporting at all is to save man-hours, and in war-time to avoid mortgaging the future by the sale of overseas securities. Because of our limited ability to pay for imports in exports or foreign securities and our restricted capacity to ship them over, there must be discrimination between different types of demand for imports, giving priority to those which are most urgent from the point of view of winning the war

The broadsheet stresses the basic importance of applied intelligence in exports; in war, it is particularly important to concentrate on those goods the selling price of which includes least matter and most mind, and the seller's market which is being created by the War should be utilized to grade up export industries instead of clinging to older and less profitable lines. Similarly, every opportunity missed of improving productive efficiency is a drag on the national effort. If new layers of demand are continually tapped and labour and capital progressively transferred to more and more advanced processes or products, the shrinkage of formerly important export industries can be faced without dismay. Moreover, if we make the inter-allied economic arrangements between France and Great Britain work effectively, we shall not only have won the war but made also the greatest possible contribution towards winning the peace

These agreements between France and Great Britain are outstanding among the actual War-time economic measures. With the joint committees on economic co-operation covering the supply and purchase of munitions, food and raw materials, shipping policy and economic warfare, they should lead to one economic policy for the two countries. This is specially true of exports. The three major elements in any export policy are the export potential, the available markets and the foreign trade policies. The nature of the export potential is the most important in a sellers' market, but exports cannot be left to take care of themselves after the needs of the armed forces and of the civilian population have been met, but must be recognized as a priority of the first importance. Among the opportunities for expansion of our exports at present, the broadsheet stresses those in machinery to complete unfinished German contracts, and those in cotton textiles, locomotives and coal.

The effect of the contraband control on export policy must next be recognized. The purpose of such control is to impede the supply of vital commodities to the enemy. This has now been extended to exports, so that Germany's direct overseas trade should soon be virtually destroyed. Particularly in Latin America, the control has created new markets for Great Britain, and for this our bargaining position is in general strong.

The second aspect of economic warfare consists in the extension of the effects of the blockade to the Continent, so as to cripple Germany's trade with those neutrals with whom contact can still be maintained. The object of promoting British exports to European countries is to turn the tide of trade heavily against Germany by raising the prices of neutral products. This involves a careful study of the strategy of economic warfare, if Germany is to be prevented from importing from neighbouring countries Strategic purchases, for example, of Rumanian oil involve British exports to pay for them. Sound export policies, moreover, can only be framed after the fullest information about markets and resources has been obtained, and such policy covers every aspect of exporting from production to marketing, including the use of bilateral or multilateral methods of approach to markets, import or export subsidies.

A large-scale purchasing programme makes a survey of the export potential more urgent, and the existence of these Anglo-French programmes is an important factor for world producers. Overseas Governments will require to know that resources are available to supply the necessary goods if they are to continue to sell to Britain, and also that exports have priority over alternative demands. The importance of paying sufficient attention to the needs of the non-self-governing colonies is stressed in the broadsheet, which adds one further plea to the many already advanced for a co-ordinator of trade policy with sufficient political status, including access to the Cabinet, to secure the full and coherent use of Great Britain's immense resources for acting as a centre of world economic expansion.

PRODUCER GAS FOR MOTOR VEHICLES

THE recently published "Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas" (London : H.M. Stationery Office, 1940. 9*d*. net) conveys conclusions only The Committee, set up by the Mines Department in May 1937, carried out extensive experimental work, including bench tests and road tests under normal operation and under scientifically controlled conditions, from which it can be inferred that a considerable body of quantitative information was derived. The data, however, have not been published, presumably it was not desirable to give details of the work at the present time

Road trials with commercial producers showed that, subject to certain inherent limitations, producer gas is a satisfactory fuel for transport vehicles The Committee was impressed by the difficulties encountered and the special conditions attending such an emergency as was envisaged, and therefore undertook the design of a simple producer which would be suitable for the conversion of existing vehicles, capable of rapid production at low cost and required only such metals, plant and labour as were likely to be available in war-time.

Although on the Continent considerable numbers of vehicles have been operated by producer gas, the small amount of progress made in Great Britain is put down to increased capital maintenance and servicing costs, reduction in power output with the consequent upsetting of operating schedules, reduced pay load and the difficulty of obtaining suitable fuel The artificial disadvantages due to such vehicles being placed in higher tax and lower speed-limit categories are probably more potent considerations. It is stated that the vehicles operated by the Committee have covered a distance of more than 170,000 miles, but no information is adduced regarding these trials Nor are any figures given of the results obtained in Continental practice, although several members of the Committee had already studied the use of producer gas vehicles on the Continent, and close watch was kept on developments taking place abroad.

The design, which the Committee states is not suggested as necessarily representing finality, appears to be suitable for vehicles up to 6 tons gross weight of 3–4 litres engine capacity. Grave difficulties in operation were found to follow relatively minor constructional defects, and failure to adhere strictly to the dimensions laid down has frequently led to trouble. The design as outlined appears to have the merit of simplicity from the point of view of manufacture and lends itself to mass production. It is suitable for use with low-volatile anthracite and certain low-temperature cokes, and may be mounted on the vehicle itself or on a trailer as thought best in each individual case. We are informed that full details regarding the plant and its working can be obtained from the Director, Fuel Research Station, London, S.E.10.

There are among the conclusions reached by the Committee several valuable items of information such as the availability of different classes of suitable fuel, effective methods of gas filtration and the classes of service for which gas producer vehicles can be most economically used.

EXPLOSIVE ACTIVITIES OF A JAPANESE VOLCANO

THE volcano Kusatu-Sirane suddenly became active with a remarkable explosion on November 27, 1937, and from that time until October 1938 it was studied in great detail by T. Minakami (*Bull. Earthquake Res. Inst.*, Tokyo Imp. Univ., 17, Part 3, September 1939, pp. 590–623). The volcano was very active during December 1937, and January and February 1938. It was more calm from April until August 1938, but became active again from the latter part of September. A rather violent explosion occurred on October 5, 1938, and after that date large quantities of gas were ejected, while ash was scattered near the *Y* crater. At the same time, volcanic pulsations and volcanic micro-earthquakes occurred and these were still continuing in February 1939.

So far as situation on the earth's surface is concerned, the active fissure differed from the fissure of previous activity of October 1932. The hypocentres of the micro-earthquakes were found to be at a depth of 1·7 km. According to geothermic measurements, the region of high temperature was restricted to the narrow zone along the active fissure. From observations of the water-level of the hot spring pond in the crater, it was concluded that the quantity of water that filtered through the fissure at the bottom of the pond amounted approximately to 750 tons a day. The gas ejected from the crater was mostly aqueous vapour, though on several days during May and October 1938 large quantities of evaporated sulphur were emitted with the steam. Boring showed that the floor of the *Y* crater consisted of alternate layers of precipitated sulphur, volcanic detritus and ash.

The presence of the sulphur gave the estimate of 444° C. for the temperature of the vapour, though often it was below this temperature. The quantity of seeping water would affect this, as would the supply of heat from the subterranean origin. Judging from the distribution of volcanic detritus, the pressure of gas at the time of the principal explosions under discussion was almost 150 atmospheres, which is slightly less than that of the explosion of October 1932 as calculated by T. Matuzawa.

H. Tsuya suggests that these explosions were phenomena near the earth's surface resembling those of a geyser.

SEVENTY YEARS AGO

NATURE, vol. 1, March 24, 1870

The Transits of Venus in 1874 and 1882

"A PARLIAMENTARY paper issued at the close of last session gives some information on what is intended to be done in the matter of the great approaching astronomical events of 1874 and 1882. . . For the proper observation of this event [the transit of 1874] the Astronomer Royal informs us that it will be necessary, after making allowance for all the aid that may be expected from foreign and colonial observatories, to organise expeditions to the following five stations —(1) Oahu (Sandwich Islands), (2) Kerguelen's Island, (3) Rodriguez, (4) Auckland (New Zealand), (5) Alexandria. At the first three of these stations . . it will be necessary to make preparatory observations for twelve months, in order to ascertain the absolute longitudes of these places, which are not exactly known. . . .

"But what I wish to call attention to at the present moment is the valuable opportunity thus afforded for still further augmenting the importance of this event to the progress of science generally, by converting these proposed astronomical expeditions into expeditions for general scientific observation. . . . The additional expense of attaching two or three qualified Natural History observers (or at any rate collectors) to these three expeditions could not be very great. The numerous American and Russian exploring expeditions are invariably accompanied by zoological and botanical collectors, nor is the money required to publish the results obtained by them grudged by the Governments of these countries. Even poverty-stricken Austria did not send the *Novara* round the world without a competent corps of naturalists . . Far from lagging behind, wealthy England ought to take the lead in such cases . .

P. L S"

Conductivity of Copper

"SIR WILLIAM THOMSON [Lord Kelvin], having had his attention directed to the very great differences that exist in the conducting quality of copper wire professing to be of the 'highest conductivity', had a large number of specimens carefully tested and the following are some of the results obtained—the quality is indicated by the resistance of a metre length weighing one gramme. The best specimen was one supplied by M Bréguet, Paris, of which the resistance was ·153 of an ohm per metre weighing one gramme. Specimens from English manufacturers varied as follows :—·165, ·169, ·171, ·178, ·206, ·213, ·221. Seven specimens labelled 'highest conductivity', stood as follows :—·156, ·182, ·201, ·205, ·223, and ·258. As it is to the interest of all scientific men that the copper wire used in electrical instruments shall be of the best quality, there should be general co-operation to discourage as much as possible the use of inferior copper. Variations in conductivity like those in the samples of copper mentioned above would produce instruments varying to the extent of 40 per cent."

MISS GARRETT has been admitted as a member of the medical staff of the East London Hospital for Children, and was appointed one of the physicians on Wednesday last. This is the first hospital in Great Britain which has recognized in this manner the female medical movement.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned

SECOND ASSISTANT BACTERIOLOGIST AND PATHOLOGIST—The Clerk of the County Council, County Buildings, Stafford (March 28).

TEACHER OF GENERAL ENGINEERING subjects, including Engineering Science, Drawing and Mathematics, etc —The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (March 29)

TEMPORARY ENGINEERING ASSISTANT in the Waterworks Department of the Halifax Corporation—Mr J Noel Wood, Waterworks Engineer, Gibbet Hill, Halifax (March 30).

LECTURER IN VETERINARY PHYSIOLOGY AND BIOCHEMISTRY at the Veterinary College, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (April 2)

GRADUATE LECTURER to teach MECHANICAL ENGINEERING subjects in the Plymouth and Devonport Technical College—The Education Office, Cobourg Street, Plymouth (April 6)

LECTURER IN THE MINING DEPARTMENT of the Doncaster Technical College—The Acting Chief Education Officer, Education Offices, Doncaster (April 10)

PROFESSOR OF ZOOLOGY—The Registrar, University College of Wales, Aberystwyth (April 15)

TEACHER OF ENGINEERING subjects—The Principal, Technical Institute, Ladywell, Dover

LABORATORY SUPERINTENDENT of the Government of Nigeria Medical Department—The Crown Agents for the Colonies, 4 Millbank, S.W 1 (quoting M/9173)

DEMONSTRATOR IN PHYSICS—The Dean, Guy's Hospital Medical School Office, Sherwood Park, Tunbridge Wells.

TECHNICAL ASSISTANT (Male) to the Adviser in Economics to the West Midland Province—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

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WAR-TIME FOOD POLICY

THE publication of "Feeding the People in War-Time" by Sir John Orr and Mr David Lubbock has served to direct public attention to a subject of the utmost importance in our war effort, namely the need for a sound and consistent policy in regard to food *

In Great Britain the public has always been interested in food questions The British Press devoted as much space to reviews and commentaries on the final report of the League of Nations Committee on Nutrition as did all the rest of the world's newspapers Now rationing has given every individual a personal interest in food supplies, certainly Mr. Morrison will not complain that the country is indifferent to the doings of the Ministry of Food

Nevertheless, the peace-time structure of the British Government machine was singularly ill-adapted to the evolution of food policies. Food supplies were not within the control of any single Minister, nor were they the principal concern of any Department of State. The Ministry of Health had a food department mainly concerned to safeguard the public from adulteration or from the cumulative effects of small quantities of preservatives. The General Department of the Board of Trade was concerned with food but, at least in recent years, mainly from the angle of the administration of import quota schemes. The Department of Scientific and Industrial Research includes the development of scientific knowledge regarding food preservation among its activities. The Ministry of Agriculture, although mainly concerned with the production of food, had no responsibilities towards the British consumer. There was thus no Ministry which could consider the food problem, either to secure adequate levels of nutrition in peace or to prepare the nation for war When the series of political crises gave warning of the imminence of war, a Food (Defence Plans) Department was established under the Board of Trade, and this body was the nucleus from which the present Ministry of Food has been developed

Having regard to this prior history, it was not surprising that the Food (Defence Plans) Department should not have been able to make more adequate preparations for food supplies before the War broke out It is true that the case for obtaining large stocks of wheat, sugar and other easily stored products was urged by Sir Arthur Salter in the House of Commons and by other authorities in the Press, but it is by no means easy for a hastily constituted department to overcome the resistance of the Government machine to new proposals As a result, Great Britain entered the War without substantial stocks of cereals, sugar and feeding stuffs, although it is understood that large supplies of edible oils and oil-seeds were obtained

In considering the food policy during war, it is as well to compare the position of Great Britain with that of Germany Under peace conditions, Germany produced 80–85 per cent of her total food requirements, while the contribution of British agriculture to United Kingdom requirements amounted to between 30 and 33 per cent when measured on a calorie basis. Such information as is available suggests that the German authorities have realized the importance of the protective foods, and hence, although there has been a falling off in the general standard of living of the German

* "Feeding the People in War-Time". By Sir John Orr and David Lubbock. Pp. vii+88. (London: Macmillan and Co., Ltd., 1940.) 1s. 6d. net.
The main argument was published in an article by Sir John Orr in NATURE of March 9, p. 374.

people, milk and vegetables have been abundant and cheap. Although Great Britain is far more dependent upon imports than Germany, the former is far less susceptible to blockade. Even if enemy action becomes more serious than it has yet been, we shall be able to rely on large sea-borne supplies reaching at least our western ports. Nevertheless, it is of the utmost importance that British agriculture should be in a position to make a maximum contribution to our requirements. This is equally important from the point of view of shipping and as a relief to the financial drain which must inevitably occur when a country mobilizes all its resources for war and must obtain large supplies of armaments, munitions and raw materials from abroad.

These points have been brought out by Sir John Orr and Mr Lubbock, but they have laid special emphasis upon another most important factor. For many months before the actual outbreak of war, indeed since the Munich Agreement, Germany has been conducting a 'war of nerves.' This war may well prove to be a contest in endurance between the English and French peoples on one hand, and the German people on the other. In such a contest it is clearly essential to pay special regard to the morale of the poorest sections of the population. Since the conclusion of the War of 1914–18, the newer knowledge of nutrition has thrown a flood of light upon the influence of food, not only on bodily health but also on the psychological reactions of the people. During 1914–18, Governments and General Staffs had little opportunity of knowing anything about such factors as the depressing effect of the lack of vitamin B_1 upon the combative spirit of armies, or the effect of shortages of the fat-soluble vitamins upon the physical, and hence upon the psychological, condition of nations. It should now be clearly realized that the staying power of a nation depends not only upon sufficient energy foods but also upon adequate supplies of minerals and vitamins.

Few will be prepared to dispute Sir John Orr's contention that, owing to the relatively high cost of the protective foods, about a third of the population of Great Britain suffer from some degree of malnutrition. This fact was established in "Food, Health and Income" and is confirmed by more recent dietary surveys. This being the case, it is not possible to disagree with Sir John's further contention that, in order to ensure the solidity of our national effort, not only must the national dietary be maintained on a satisfactory basis, but also steps must be taken actually to improve the diet of the poorest third of the population. To achieve this end Sir John Orr and Mr. Lubbock propose to adopt for food the more general proposals for an 'iron ration' suggested by Prof. J. R Hicks and commended by Mr. J. M. Keynes. They propose that adequate supplies of a limited number of foodstuffs, selected on grounds of health and availability, should be sold at prices which would ensure that the poorest 10 per cent of the community, who may not have more than 4*s*. 6*d*. a head to spend upon food, should be enabled to purchase their full requirements of these foodstuffs at a price of not more than 3*s*. a head a week ; thus leaving 1*s* 6*d* a head to spend according to their tastes on other foods. It is tentatively suggested that the following foods should be selected: milk, potatoes, oatmeal, vegetables, bread, sugar and either butter or vitaminized margarine It is maintained that, provided everyone could obtain full supplies of these seven foods, there would be no shortage of vitamins, and calcium requirements would be fully met, as well as those for other minerals. Of these foods four, namely milk, potatoes, oatmeal and vegetables, could be wholly produced in Great Britain. There is no suggestion that imports should be limited to wheat, sugar and fats, but rather that these three essentials, together with perhaps cheese and dried fruits, should be given priority on shipping space so that stocks could be built up in the country.

It is of vital importance that the policies of the British Government in regard to food and to agriculture should be so closely correlated as to be, in effect, complementary parts of the same policy. It can scarcely be claimed that this is the case to-day. Apart from the general ploughing-up policy, no clear indication of the part which British agriculture should play in the War has been given by responsible Ministers. On the other hand, the present guaranteed prices are likely to result in an enormous increase in the growing of oats, a substantial increase in wheat, and the maintenance or even increase in the fattening of cattle and sheep.

A simple method of ensuring the fullest possible production of milk, potatoes and vegetables is proposed. Farmers would be offered guaranteed markets at attractive prices for these products, not only for the War, but also for at least a three-year period after the War. This method would secure the aims sought, provided steps are simultaneously taken to discourage, by less attractive prices, an undue concentration upon

cereal production or the feeding of imported concentrates to fatten cattle and sheep.

Vegetables, other than potatoes, constitute a special problem. Allotments will increase supplies, but not nearly to a sufficiently large extent. It is also necessary to stimulate farm production and to ensure that the vegetables are made available for retail sale at low prices. If, to give effect to this latter purpose, vegetable marketing is placed upon a more satisfactory basis, we shall have achieved in war something which has defeated us in peace.

It is not to be expected that the proposed food policy will obtain the support of all authorities, or that it will not encounter the opposition of special interests. The co-ordination of agricultural and import policies is, however, one of the most necessary of war measures, and the proposals under discussion do provide a logical basis for such a policy. It is also important to realize that the orientation of British agriculture towards milk and vegetable production has been advocated in the Astor-Rowntree report and by many other authorities. This war-time policy might, therefore, be expected to need little modification to adapt it to the conditions of peace

PURE EXPERIMENT

Experimentelle Cytologie
Von Hans H. Pfeiffer (New Series of Plant Science Books, Vol. 4.) Pp. xii + 244. (Leiden Chronica Botanica Co.; London: William Dawson and Sons, Ltd., 1940). 7 guilders; 18s.

EXPERIMENTAL cytology is both more and less than its name seems to say. To understand why, we have to look into its antecedents. It springs largely from the conflict of fifty years ago between vitalism and mechanism. It derives from the tradition born of this conflict, that the individual processes in the cell were physico-chemical processes and that the cell as a whole, and even the organism as a whole, were to be completely understood by measuring and putting together these individual processes. Inspired by this doctrine, and inspired as well by the missionary zeal of Jacques Loeb, experiments were carried out which achieved their first purpose. They drove vitalism into the philosophical backwoods of biology, and in performing this apparently negative service they laid what should have been the foundations of a new science

But unfortunately, while this was going on, a cleavage arose in experimental method. It was discovered that experiments of a rigorous kind could be carried out with the cell using biological as well as physical variables. Measurements could be made not only with variations in physical agents, such as temperature and pH, using physical properties, such as refractive index, surface tension, permeability, osmotic pressure, viscosity, specific heat and so on. They could also be made with variations in biological agents, such as genes, chromosomes, and nuclei, affecting biological properties measured in different ways and with different degrees of refinement. The methods used with these two kinds of approach became more divergent as the apparatus and the technique of each method became more elaborate. It is therefore important to see after this lapse of time whether the divergence depends on a necessary cleavage of purpose or whether it is perhaps artificial and spurious.

The "experimental" cytology which Dr. Pfeiffer describes is of the physical kind, and we have to admit that it still has the character of transplanted physics. After a lifetime of transplantation it does not appear to have developed an organic or integrated quality. It amounts to little more than a catalogue of measurements of the properties already referred to, a catalogue so disconnected that its several sections can be read in any order without loss of coherence. The method and the apparatus, it seems, are the connecting links, and not the results obtained by them. Where we might hope for analysis we find only description. The wheel has come full turn. Experiment having lost its purpose has lost its design. It has ceased to be an instrument of planned discovery and has become merely a repetitive occupation.

This decay in physical cytology was noticeable to some observers ten years ago. To-day in Dr. Pfeiffer's book it has become obvious by contrast with the biological method. The physical approach has been to the cytoplasm. It has yielded, as we may say, a series of anecdotes. The biological approach has been to the nucleus. It has yielded a connected story. The reason is perhaps a surprising one. The nucleus owes it predominance over the cytoplasm in growth and heredity not so much to a greater complexity of its components as to the permanence and precision of their structure. This precision has been shown by tests of X-ray mutation, ultra-violet spectroscopy and

micro-chemistry combined with the general body of comparative and analytical cell and genetic studies (all of these left out of consideration by Dr. Pfeiffer). This in turn has meant that physical, chemical and biological methods of attack on the nucleus could be used, and used in combination, in a way that has not been possible in dealing with the undefinable cytoplasm, and in this attack, strangely enough, no one is any longer concerned to know whether the analytical operation is experimental or whatever the alternative may be.

Dr. Pfeiffer's book does a service in making the lesson of this contrast clear The cell is a physico-chemical mechanism, but it is a highly integrated mechanism. This integration can never be understood by means of experiments using variables of one kind alone, external or internal We have to know it at each level of integration before we can fit the different levels together. Wherever we see a chance of such fitting together we must seize it.

"*Dich im Unendlichen zu finden*
Musst unterscheiden und dann verbinden."

For this task, planning and co-ordination are necessary at every step. The co-ordination requires that we shall break down the segregation of plants from animals, of chemistry from genetics, and of experiments from less refined demonstrations. The planning requires that we shall not merely ask the right questions but ask them in the right order, without regard to departmental exclusiveness or (may we say it?) technical snobbery.

C. D. DARLINGTON

THE HISTORY OF GEOLOGY

(1) The Birth and Development of the Geological Sciences
By Dr. Frank Dawson Adams. Pp. v+506+14 plates. (London: Baillière, Tindall and Cox, 1939.) 22*s*. 6*d*.

(2) A Source Book in Geology
By Prof. Kirtley F. Mather and Dr. Shirley L. Mason. (Source Books in the History of the Sciences Series.) Pp. xxii+702. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

IT is now more than thirty years since a comprehensive treatise on the history of geology has appeared in the English language. For long Sir Archibald Geikie's admirable "Founders of Geology" and von Zittel's "History of Geology and Palæontology" have been the standard and, in fact, almost the only works exclusively devoted to this subject available for students. Since they were written, fresh studies in the history of geology have appeared from time to time, both in Europe and the United States. These have generally been of a more or less specialized character, and they have by no means exhausted the scope for further research. The appearance of two important new books on this subject is therefore a matter of considerable interest, particularly because both the original German edition of Zittel and the English translation by Mrs. Ogilvie-Gordon have long been out of print.

(1) The "Birth and Development of the Geological Sciences" was written during the author's retirement, after a lifetime of active geological work, and the story of how it came to be undertaken is worth telling. The fantastic theories put forward in past centuries to explain even the most commonplace of geological phenomena, such as the occurrence of minerals and fossils, aroused Dr. Adams's curiosity many years ago. Not content with reading about them at second-hand, he formed the habit of referring, when opportunity offered, to the original text of some of the more important early writers. Ultimately a growing interest in the subject led him to search out the works of other, less well-known authors. Thus, as time went on, he acquired an intimate knowledge of the byways as well as the highways in the early literature of natural science, in which are to be found the germs of present-day geological knowledge. In addition, in order to satisfy the necessity for repeated consultation of some of these early works, Dr. Adams, whenever possible, obtained copies for himself. In taking this course he followed, literally, the advice given as long ago as the fourteenth century by a very early booklover and collector, Richard de Bury, Bishop of Durham, which he quotes as follows, ". . . we secured the acquaintance of stationers and booksellers, not only within our own country, but of those spread over the realms of France, Germany and Italy, for no dearness of price ought to hinder a man from the buying of books, if he has the money that is demanded for them . . ." As a result, during the process of widening his knowledge of his subject, the author built up a specialised library, containing more than a thousand volumes in various languages, many of extreme rarity.

The belief, modestly expressed by Dr. Adams, that the knowledge derived from studies carried out during more than twenty years might prove

of value to others unable to carry out such researches for themselves, fortunately induced him to prepare his notes for publication. The resulting book is, he explains, an attempt to trace the evolution of geological ideas from the first period of which we have any written record in Europe, that of the early Greeks, on through Classical Times, the Middle Ages and the Renaissance, down to about the year 1825, when geology as we know it to-day began its rapid development. The latter limit is not rigidly adhered to, since one or two chapters have been rounded off with a very brief outline of the later history of the particular subject dealt with, but no serious attempt has been made to discuss the period subsequent to this date.

The ground covered is indicated by the following list of chapter-headings: bibliography and sources; geological science in Classical Times; the conception of the universe in the Middle Ages, on the generation of stones; medieval mineralogy, the birth of modern mineralogy and its development from Agricola to Werner and Berzelius; the birth of historical geology with the rise and fall of the Neptunian theory; 'figured stones' and the birth of palæontology; the origin of metals and their ores; the origin of mountains; earthquakes and the nature of the interior of the earth, the origin of springs and rivers; quaint stories and beliefs; conclusion.

Dr. Adams makes the somewhat bold statement that few books likely to contain matter of real importance to his study remain unexamined by him, but after reference to the text no one is likely to dispute this claim, nor, indeed, the truth of the remark that his extensive reading proved the aptness of Bacon's aphorism, "Some books are to be tasted, others swallowed, and some few to be chewed and digested". Obviously some of the works consulted can have contained little that has a direct bearing on the subject, although, no doubt, they provided material to form the background essential for a proper appreciation of much that he has to say. Of this nature is the interesting chapter on the conception of the universe in the Middle Ages.

Dr. Adams deals more fully than previous authors with the ideas prevalent during the centuries preceding the emergence of geology as a separate branch of knowledge. It is impossible to refer in detail to the results of his researches into the early literature of science and natural history but I may mention one example. He discovered, and quotes at length, in translation, a hitherto almost unknown and exceedingly rare little book entitled "De Montium Origine". This was written by Valerius Faventies, and published at Venice in 1561, and, so far as is known, is the first treatise written in Europe dealing exclusively with the origin of mountains. Though its ideas are largely speculative, they are of interest, as Dr. Adams points out, in giving a picture of the manner in which a geological problem was approached in the later years of the sixteenth century. The treatise is cast in the form of a dialogue between two members of a party of friends, in a manner reminiscent of Boccaccio's "Decameron". Neither of the disputants gives any indication that he had ever climbed a mountain in his life, nor that he had any desire to do so. The days of geological field work had not yet dawned.

The formative years of geological science, the eighteenth century and the early years of the nineteenth century, are by no means neglected, and in dealing with this period Dr. Adams again quotes authors not referred to by either Zittel or Geikie, and other sources not available at the time these authors wrote, so that our knowledge of this period also is enlarged. The chapter on the birth of historical geology, for example, contains a particularly interesting and informative account of Werner and his doctrines.

Fortunately for his readers, Dr. Adams combines with a deep knowledge of his subject the ability to expound his store of knowledge in a charming and lucid style, and the result is a book that can scarcely fail to give pleasure to all who read it. Its attractiveness, too, is greatly enhanced by the inclusion of nearly one hundred illustrations, mostly reproductions from old scientific books. Yet the especial merit of this new history of geology is not merely that it is readable, or even that it adds so considerably to existing knowledge, but that the author has in every case gone back to original sources for his information. Thus, though his book does not supersede those of Zittel and Geikie, it must be regarded as the most authoritative work on the particular aspects of the subject with which it deals.

Unfortunately, a few small defects mar this otherwise excellent production There are a number of typographical errors, some affecting the spelling of proper names, and others the dates of works to which reference is made. In addition, in one or two instances footnote references have been put in such a form as to cause difficulty in tracing the actual work to which it is intended to refer. Further, the value of the book as a work of reference would be correspondingly increased if the index were expanded.

Dr. Adams informs me that he intends to present his library to McGill University, where it will be housed in good company with the late Sir William Osler's collection of books on the history of medicine. It will then be known as the "Adams' Collection". A library of this type can only be

built up after years of patient search, backed by adequate knowledge and sufficient means. It is welcome news, therefore, that Dr. Adams's unique collection is not to suffer dispersal, the fate of many important private libraries Its value will be better appreciated after publication of the catalogue, on which the author is at present engaged.

(2) Opportunities for reading original texts of the type so largely represented in the Adams Collection are few. Many are written in Latin, and of these only a small number have been translated into any modern language ; and, in any event, they are seldom accessible to the average reader. Those who may wish to consult works of this sort will be interested to learn that their needs have now been met, to some extent, by the publication of Mather and Mason's "Source Book in Geology".

This is the fourth in a series of "Source Books in the History of Science", published under the general editorship of Gregory D. Walcott and an advisory board of American men of science, assisted by special committees for each science. The enterprise has also received financial aid from the Carnegie Corporation of New York The object of these "Source Books" is to make readily accessible the significant passages from the works of the most important contributors to the major sciences during the last three or four centuries, up to the end of the nineteenth century. Each therefore consists of a large number of quotations, carefully selected with as much finality of scholarship as possible. These are given in English translation when necessary, a decided advantage in the latest volume, in which nearly half the extracts were originally written in languages other than English.

In this volume the term 'geology' has been interpreted in its widest sense, and twenty-nine separate divisions of the science are represented. The compilers, in choosing their material, have attempted to strike a balance between the needs of readers interested in the science as a whole, and those of students concerned only with a particular branch of the subject. Preference has been given, where other considerations are nearly equal, to excerpts from sources least likely to be accessible to the majority of geologists.

The scope of the book may be judged from the fact that it includes three hundred and twenty-nine extracts from more than one hundred British, Continental and American authors, ranging in time from the fifteenth to the end of the nineteenth century. Contributions to geology made since 1900 have not been included, nor those by living authors. The excerpts are, in general, arranged in chronological order according to the date of birth of the authors, and a subject index is provided.

The task of compiling this book must have entailed an immense amount of literary research. Of its kind it is a pioneer work, and it may be said at once that the task has been well done. It is unlikely that complete agreement could have been obtained among the many collaborators as to the final selection of authors whose work should be quoted, and, in fact, this is hinted at in the preface. The compilers, however, accept responsibility for the final choice In glancing through the pages of the book, one is struck more by the number of names included, many well known, others unfamiliar, than by the few questionable omissions Yet a few names outstanding in the history of geology are missing. Among these may be noted that of Palissy the Potter, whose observations on fossils, made in the sixteenth century, it would have been interesting to read. The work of Lehmann and Füchsel, too, who made important stratigraphical observations in the eighteenth century, might well have been included. The original writings of these authors are to be found in very few libraries. In contrast, extracts have been given from the works of men of science not usually associated with geology, such as, for example, Robert Boyle. His observations on the conditions prevailing at the bottom of the sea, though of interest, are not original, and can scarcely be said to have had much influence on the development of geological thought. Cavendish, too, was not primarily a geologist, but, with more justification, an extract has been given from the account of his experiments to determine the density of the earth by means of the torsion balance In reading this account, one is reminded of the interesting fact that this instrument of precision, now the tool of the geologist and prospector as well as the physicist, was actually invented by a geologist, John Michell, in the eighteenth century.

Though, perhaps, to be regarded primarily as a work of reference, this is a book into which any geologist can dip with the expectation of finding something to interest him. It forms a valuable supplement to the existing histories of geology, and the compilers are to be congratulated on the thorough and painstaking manner in which they have carried out their task.

The literature on the early history of geology has been greatly enriched by the publication of the two books reviewed above. Dr. Adams has dealt fully with the long period ending in the early years of the nineteenth century, and Mather and Mason record the chief landmarks in the history of the science from the fifteenth right up to the end of the nineteenth century. The detailed story of the development of geology during the last hundred years, a period of great expansion in every branch of the subject, still awaits an author.

V. A. EYLES.

THE GOLGI APPARATUS

Form- und Stoffwechsel der Golgi-Körper
Von Gottwalt Christian Hirsch. (Protoplasma-Monographien, Band 18.) Pp. xi+394. (Berlin: Gebrüder Borntraeger, 1939.) 28 gold marks.

THE author of "Form- und Stoffwechsel der Golgi-Körper" attracted attention by his papers published in 1931, in which he claimed that the zymogen granules of the pancreas acinus cells originated not inside the Golgi apparatus, but drifted into that position from the base of the cell, where they originated in contact with the mitochondria.

Dr. Hirsch's claim was examined in my laboratory by E. S. Duthie in 1933, who agreed that very small granules were continually drifting across the cell into the region of the Golgi apparatus, where they swelled into zymogen. It cannot be said that Dr. Hirsch's work has been received everywhere with warmth among those cytologists who believed that practically all cell secretion granules *originated* inside the Golgi apparatus. Recently a strong attack on Hirsch and Duthie's work has been made in the *Quarterly Journal of Microscopical Science* by the competent Indian cytologist, Dr. Subramaniam, as a result of his investigation on the endostyle of *Branchiostoma indicum*. Nevertheless, Dr. Subramaniam fails to show what connexion the zymogen granules in the pancreas of the mouse have with the secretion of mucus in Branchiostoma, and as matters stand at present Dr. Hirsch's results must be accepted

Following his interesting work on the pancreas, Dr. Hirsch has now written a book on the Golgi apparatus. He has read 2,000 papers on this subject, and appears to be convinced that there is such a thing as the Golgi apparatus. Furthermore, most of his ideas on the actual structure of the Golgi apparatus will be generally acceptable to British and American cytologists.

As is natural, the book deals more fully with the histological aspect of the subject, but Dr. Hirsch has interesting sections on spermatogenesis and oogenesis. One astonishing point about Dr. Hirch's book is the calmness with which he endeavours to harmonize the very different and apparently incompatible results of cytologists who have been sharply at variance in recent years. But Dr. Hirsch has tried to provide a view of this confused subject which might show the results of the workers of all countries in the best light, and he has certainly succeeded in this object very fully. Indeed, it could have been said in happier times that his book would have been certain to have inspired many of the younger zoologists and physiologists to undertake their life's work in this branch of cytology.

It is pleasant to read that Dr. Hirsch accepts the nature and homology of the plant osmiophilic platelets (Golgi bodies) discovered by the American cytologist, the late Robert Bowen. Dr. Hirsch dedicates his book to the curators of the University of Utrecht in gratitude for the opportunity given him of working there.

Dr. Hirsch's book, and the interesting researches of W. Jacobs, W. Buchmann, E. Ries, L. H. Bretschneider, J. W. Sluiter, O. Järvi and many other young Dutch cytologists, bear witness to the very valuable work now being carried out at Utrecht under his leadership

J. Brontë Gatenby.

CAPTAIN JAMES COOK, R.N., F.R.S.

The Life and Achievements of Captain James Cook, R.N., F.R.S.
Explorer, Navigator, Surveyor and Physician. By Surgeon Rear-Admiral John Reid Muir. Pp. vii+310+16 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 10*s*. 6*d*. net.

THE consideration of Cook as the 'physician' rather than the astronomer, surveyor and explorer well deserves this pleasant story. It is the central theme, which the author is well qualified to undertake, in the summaries of his three voyages, to the neglect of much consideration of their value to scientific knowledge; however, his bibliography is so short that more cannot be expected. Cook served his apprenticeship in small colliers trading along the English coasts. He chose similar ships for his voyages, and his knowledge of their capabilities was a large element in his success. His observations on the eclipse of the sun as seen in Newfoundland in 1766 caused him to be appointed by the Royal Society as its chief

observer of the transit of Venus viewed afterwards from Tahiti in June 1769 A further object was the discovery of the great southern continents, a current myth at that period, the second expedition having this as its main objective ; the third was primarily concerned with the North-West Passage. Cook everywhere found new lands, and nearly every chart of the Pacific is headed by his name His running survey of New Zealand, which he completely circumnavigated, causes him to be regarded as the leader and greatest of that line of surveyors that has made the Navy famous This had been especially brought out by the late hydrographer, Admiral Sir W. Wharton, in his studies of Cook, the error in the longitude of the observation station at Tahiti being only two minutes. That Cook attained international fame during his life is seen in that France, the United States, Spain and Russia extended to his third expedition a safe conduct in that war period

Even the most careful research has yielded little knowledge of the character of Cook, while nothing is known of his domestic life We judge that he was a reserved and lonely individual. That he was a personality with the necessary power of command is clear, in that the Admiralty gave him *carte blanche* in selecting his stores and crew. Among seamen his reputation was such that he had not to resort to the press-gang and to jailbirds, thus avoiding the danger of typhus then so rife. The result is seen in that his ship was not the prison as naval vessels were usually in those days, shore camps being established and leave frequent.

The great danger was scurvy, and long voyages often had to log a death-rate of 50 per cent or even more The best authenticated case is Anson's voyage round the world in 1741, in which out of crews numbering 961 more than two-thirds died of scurvy, and on the homeward voyage only 71 were able to stand to their guns. Everywhere Cook's first care was water, which was never rationed, this an essential of a salt-meat diet. Every land was searched for scurvy grass, wild celery and other vegetable products, while fresh meat was purchased wherever possible. The strictest cleanliness was enjoined, Cook inspecting his crew twice weekly, while their quarters were ventilated and fumigated weekly, a proceeding recommended by Dr. Lind in 1753. It was forty years later that the Admiralty commenced the issue of lime juice, which has no antiscorbutic vitamins, a tragic error due to a confusion of names (lemon *v* lime) that persisted for more than a hundred years. Cook largely relied on portable soup made of desiccated meat and bones, greens stored with salt which was termed "sour kraute", malt and beer concoctions, while fresh meat was everywhere sought. The results are well seen in Cook's voyages, as in all three the loss from scurvy was negligible, far less than that from Batavian dysentery and malaria while repairs were being carried out on the *Endeavour*

TRIGONOMETRICAL TABLES WITH THE ARGUMENT IN TIME

Seven-Figure Trigonometrical Tables for Every Second of Time

Prepared by H.M. Nautical Almanac Office (Published by order of the Lords Commissioners of the Admiralty) Pp 102. (London : H.M. Stationery Office, 1939) 10*s* 6*d*. net

COMPUTERS are well aware of the difficulties experienced in dealing with right ascension, hour angle, etc , in astronomical work, when trigonometrical functions of these are required. It is necessary to convert them into degrees, minutes and seconds of arc before tables of trigonometrical functions can be used, and tables with the argument in time have been in demand for many years. The present volume supplies a need and is the first seven-figure table to be published which gives the four natural trigonometrical functions chiefly used in astronomy and related sciences, intervals of one second of time being used throughout.

The preparation of the tables was completed about twelve years ago under the direction of Dr L. J. Comrie, formerly superintendent of H.M Nautical Almanac Office, but approval for publication was not obtained until 1932, and the printing has been delayed for various reasons. Manuscript tables have, however, been in use in the N.A Office for about seven years, and the table of tangents has been utilized in the computations of the right ascensions of the sun, moon and planets.

Seven decimals have been retained except in the cases of the cotangent. Here the number of decimals depends upon three desiderata : (*a*) linear interpolation ; (*b*) the same number of significant figures as the tangent ; (*c*) sufficient figures to enable inverse interpolation to give a mean accuracy of 0·001s., but as the first and

third of these cannot both be satisfied everywhere, the scheme adopted is based mainly on (*b*). In some cases values of the cotangent to more decimals than are tabulated or to more than can be easily interpolated, are required, and to meet this need there is an auxiliary table containing the function $\tau = x^s \cot x^s$ to three decimals, for every second of time up to 30m. Eight significant figures can be obtained from this table by simple interpolation, and the cotangent or tangent can then be derived to seven significant figures by simple division. In both tables the greatest and least differences in any column are given at the head and foot of each column, no interlinear differences being given, and this arrangement enables the complete difference to be obtained from an inspection of the end figures.

The table is naturally intended for use with a computing machine, and computers are recommended to utilize the methods of direct and inverse interpolation which have been explained very fully in the "Nautical Almanac" for 1937, and reprinted in "Interpolation and Allied Tables" (H.M. Stationery Office, 1936). It should be added that the printing and reading of the proofs have been carried out under the direction of the present Superintendent of the Nautical Almanac Office. M. D

VIRUS RESEARCH

Methoden der Virusforschung

Von Prof. Dr. Henrique da Rocha-Lima, Dr José Reis und Dr Karl Silberschmidt Pp. viii + 384. (Berlin und Wien: Urban und Schwarzenberg, 1939.)

FOR years the study of viruses was closely linked with bacteriology and mycology, descriptions of viruses occupying only minor parts of books devoted mainly to bacteria and fungi. This followed inevitably from the widely held belief that viruses differed essentially from other recognized pathogens only in size, and from the fact that they were investigated almost exclusively by a few enterprising bacteriologists and mycologists. Recently, however, the outlook has changed. A growing appreciation of the economic importance and scientific interest of viruses has attracted workers in other fields, and the need for separating viruses from other pathogens has become more and more obvious. One result of this has been the increased production of books dealing exclusively with viruses, of which that under review is the fifth to appear within two years.

In many ways this book differs from those previously published. One advantage it has is that the subject is treated as a whole. No gross distinctions are made between viruses attacking animals, plants and bacteria, all of which are dealt with under the same general headings, the book being kept to a reasonably small size by the omission of details of disease symptoms. A disadvantage is that the authors neither discuss controversial points nor criticize the work they describe. However, it is more than the description of techniques suggested by the title, for full details of the results obtained are also given, and, with one qualification, it is fairly described as a good, impersonal summary of experimental work on viruses. The gathering together of so much work published in a large number of apparently unrelated journals will be useful to most workers, but will probably be of greatest value to those who have not ready access to good library facilities.

The book is divided into three main sections, dealing respectively with viruses in diseased organisms, infection methods, and the properties of viruses *in vitro*, of which the last occupies about two thirds of the whole. The techniques described range from the construction of insect-proof glass-houses and the culturing of insect vectors, through such subjects as transmission, ultra-microscopy, ultra-filtration, centrifugation, cataphoresis, and serology to tissue culture and the culturing of viruses in developing eggs. Nevertheless, in spite of the variety of methods described, all those used in work on viruses are not included. This is, no doubt, a direct reflection of this book's greatest fault, which is that it is already out of date. Except for a short supplement containing references to a few papers published in 1938, the last papers referred to were published early in 1937. As a result, not only are the many advances made in the last three years excluded, but often undue prominence is given to methods that would no longer be used.

The illustrations are all line drawings and, although some of these may be an aid to the text, it is difficult to see what is gained from the inclusion of others, such as Figs. 1, 31, and 51. As the book is presumably meant as a laboratory handbook rather than one to be read, it is a pity it is not better bound, for it is unlikely that the flimsy paper cover and the loose stitching will withstand much handling. F. C. Bawden.

OUTBREEDING AND SEPARATION OF THE SEXES

By Dr. K. Mather,

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Gametic Differentiation and Separation of the Sexes

THE process of sexual reproduction shows two remarkable features, namely, that in all but some of the lowest organisms there is gametic differentiation, the male and female gametes being morphologically and functionally distinct, and that there is, in some plants and most animals, separation of the sexes, the two kinds of gametes being produced by different unisexual zygotes.

The former phenomenon may very reasonably be interpreted as showing a division of labour. The female gamete is larger and contains, or is associated with, food stores, which may be utilized by the developing embryo, while the small male gamete is more motile and seeks out the less active egg prior to fertilization. Such a division of labour would appear to have a selective advantage and so would be favoured

The reason for the separation of sexes is, on the other hand, not so easy to understand, more especially as it is far from being a universal property of sexual reproduction. A number of arguments have been put forward seeking to account for the known facts, and nearly all of them, in some way or other, relate unisexuality to differentiation of the gametes. Two fairly recent examples may be mentioned.

Waddington[1] discusses the phenomenon in the following words: "Probably, then, the original mechanism [of sex determination] was an alternative mode of reaction in the gamete itself. . . . Usually, however, the time at which the alternative is decided is pushed further back in the life cycle, probably on a safety first principle. Eventually, in the higher animals and plants, the sex determination of a gamete has been pushed back to the fertilization of the zygophase before". The sexes are separated supposedly in order to ensure that the gametes are differentiated.

In the higher plants, however, separation of the sexes is sporadic rather than regular, although the gametes and their associated tissues are as successfully differentiated, morphologically and functionally, as in animals. Furthermore, in certain plants and animals the sex of a unisexual individual may be controlled environmentally though its gametic differentiation is perfect and regular. Nor should gametic differentiation itself be regarded as a necessary part of sexual reproduction. Many Thallophyta have successful sexual reproduction with no differentiation, or, at least, no morphological differentiation of the gametes. Thus sexual separation can scarcely be considered to be merely a predetermination of gametic differentiation, though this aspect may, of course, play some part in the evolution of the diœcious state. Any hypothesis seeking to account for unisexuality in most animals must also provide a reason for the widespread hermaphroditism in plants.

Altenburg[2] has advanced a different view. He notes that hermaphroditism is related to sluggishness and sessility. Then by means of a highly ingenious argument he concludes that the monœcious and diœcious states are adapted to the minimization of the work involved in reproduction. Thus insect-pollinated plants are, he claims, all hermaphrodite, as they need expend little work in the production of male gametes, the insect ensuring that the pollen is transferred to a stigma; so they can distribute the reproductive load evenly between individuals only in this way. Wind-pollinated plants, on the other hand, expend relatively more energy in the production of pollen, much of which is lost in the air, and, the male and female loads being more nearly equal, they may as economically be diœcious as monœcious.

A similar argument is advanced for sessile and motile animals. Sessile forms have, like wind-pollinated plants, a large male load and so are indifferently hermaphrodite or unisexual. Motile animals may minimize the expenditure on sperm production by transference following coition, and so should be analogous to insect-pollinated plants. They are, however, unlike the plants in that they are not in general hermaphrodite. The reason given for this is that they overcome the difference in male and female reproductive loads by polygamy, sexual dimorphism and sexual differences in life-span.

There are a number of objections to this argument. In the first place, it is not clear why freely motile animals should be hermaphroditic less often than sluggish ones, when insect-pollinated plants are supposedly less often unisexual than anemophilous forms. In the second place, Altenburg goes too far in supposing that all insect-pollinated plants are hermaphrodite. *Silene Otites*, *Melandrium dioicum* and *Rubus Chamæmorus* are examples of diœcious entomophilous forms. Whether separation

of the sexes is actually less common among insect-pollinated species is difficult to say as the available records are not always trustworthy, though some such correlation is suggested (cf. Lewis[3]). Finally, it is far from certain that wind-pollinated plants do in general produce more pollen per seed set than do insect-pollinated ones. Extreme examples of excessive pollen production by both kinds of plant could be cited, but it is doubtful whether statistics adequate to settle the question have been obtained. The same may be said of sperm production by animals. Until these objections have been successfully met, Altenburg's hypothesis cannot be accepted without crippling reservations, though it may be applicable to special cases.

Sexual Reproduction and Separation of the Sexes

There is, however, another approach to the question which helps to make clear the reasons for sexual separation occurring in some cases and not in others.

First of all, it is necessary to dismiss the developmental-genetic idea that separation of the sexes is of necessity related to gametic differentiation. Such differentiation has its own function in relation to nutrition of the ensuing zygote and is present, often in an elaborate form, in both hermaphroditic and unisexual organisms. The morphological analogy between gametic and zygotic differentiation is only misleading.

There is, however, one inevitable consequence of the diœcious state which enables us to understand its occurrence. If the sexes are separate, fertilization must always involve gametes from different zygotes and, in the vast majority of cases, these zygotes must be genetically distinct. It is essentially a mechanism for the promotion of outbreeding.

Now the importance of sexual reproduction to living organisms is that by its aid a higher degree of hybridity and effective recombination may be achieved than would be possible with purely asexual propagation. An increase in the effective recombination allows of a more rapid response to the action of natural selection (Fisher[4], Muller[5], Darlington[6]). Thus outbreeding is an essential feature of sexual reproduction in that it necessarily leads to greater hybridity and so, ultimately, to a greater response to selection, than does inbreeding. It is not clear that the maximum advantage will always follow from maximum outbreeding. On the contrary, there is some evidence that species have an optimum degree of hybridity, which optimum may depend on the environment. This question is, however, too complex and uncertain to be given detailed consideration here. It is sufficient to note that outbreeding is an essential part of sexual reproduction.

It is, then, easy to see that unisexuality is of advantage by virtue of its ensuring some degree of outbreeding, and hence its occurrence is a simple adaptation for the more successful results of sexual reproduction.

There are, however, other mechanisms which will achieve the same purpose. Incompatibility is found in Angiosperms and the Fungi, and also most probably in the sea squirt *Ciona*. In the Fungi it apparently depends on the aversion of the haploid hyphæ, and in the Angiosperms on a rather complex relation of the pollen tube and stylar tissue. The genetical basis of incompatibility varies, though in Angiosperms it is usually of the type first described in *Nicotiana* by East. A related mechanism is that of illegitimacy found, for example, in *Primula* and *Lythrum*. It differs from incompatibility in that it is dependent on the genetical relations of the zygotes bearing ovule and pollen, and not on the genetical relations of male gamete and female zygote. These species, together with others, also show heterostyly, which presumably encourages crossing, though the efficacy of this mechanical method is open to doubt, as it is so frequently accompanied by an incompatibility or an illegitimacy mechanism. Protandry, protogyny, special floral arrangements and other devices could also be listed.

Now these various methods, though widespread, are rarely, if ever, found where the sexes are separated. They are alternatives to unisexuality. So our conclusion that the separation of sexes is simply a method of encouraging cross-breeding is strengthened, as such encouragement is the only effect common to all these mechanisms.

Distribution of Outbreeding Mechanisms

If we are to regard unisexuality simply as one of a number of outbreeding mechanisms, it is necessary to account for the fact that it is frequently found in some groups, for example, the higher animals, but rare in others, for example, the higher plants, being often replaced in the latter case by one or other of its alternatives.

To understand this, let us compare the action of unisexuality and incompatibility. In a diœcious species an individual can cross with only a portion of the remaining population, namely, those of the other sex. Unless some way is available whereby each individual of at least one sex can seek out a member of the other sex with which to mate, so ensuring that its gametes are not wasted, there must be a large loss of reproductive energy due to maldistribution of the gametes. In most

animals such wastage is, however, much reduced by the presence of such a discriminatory mechanism whereby the motile male seeks out the female and transfers sperm directly to the egg by coition. This cannot be done in higher plants.

The incompatibility mechanism is superior to unisexuality in that it leads to less gametic loss where indiscriminate mating prevails. In the *Nicotiana* type of behaviour, pollen only fails to function when it falls on to the stigma of a plant carrying the same allelomorph of the incompatibility gene as does the pollen itself There may be a very large number of such allelomorphs More than a hundred have been found in wild *Trifolium*. The actual gametic loss is inversely proportional to the number of allelomorphs and so may be very small Hence the incompatibility mechanism has an advantage over unisexuality where no discriminatory mating is possible. On the other hand, no easy mechanism, such as mobility, can be developed to assist discrimination where so many genetic classes are involved. So unisexuality with discrimination may exceed incompatibility in efficiency, in the case of motile organisms, where the loss due to unisexuality can be reduced effectively to zero. Furthermore, there must be some mechanism for sorting out incompatible male gametes before they meet the egg, or otherwise loss of female gametes may result. This is done in the higher plants by the stylar tissues, but it would not be possible in most animals where fertilization takes place in a duct or in open water.

Hence it can be seen that there is a reasonable explanation for motile animals depending mainly on unisexuality while higher plants usually adopt incompatibility or an analogous system of gametic discrimination. In the former case, wastage from separation of the sexes is reduced by means of mate discrimination, whereas an incompatibility mechanism would be difficult to operate. In plants, mating discrimination is difficult but incompatibility easy to operate.

The above remarks about incompatibility apply equally well to the closely allied illegitimacy mechanism The other outbreeding devices found in plants may also be considered in a similar way. Protandry, for example, discourages self-pollination in the same flower, where its risk of occurrence would be greatest, while ensuring that the rest of the population are capable of receiving the pollen after its release. It is not, however, a fool-proof device for securing outbreeding.

Thus unisexuality may be regarded as one of a number of devices which arise by reason of their encouragement of outbreeding.[6] The one to be adopted in a particular species depends on its special features, though the most suitable mechanism may not always develop. Thus if the disadvantage of wastage following on separation of the sexes in a plant is less than the advantage gained by the encouragement of outbreeding, unisexuality might occur but would be liable to be weeded out as soon as environmental conditions reversed the magnitudes of these opposite effects. So the diœcious state is a transient feature of some Angiosperms. It is also clear that some species which are in a stable environment, to which they are highly adapted, may find recombination a disadvantage and so suppress outbreeding mechanisms or even substitute inbreeding adaptations as in *Pisum* and *Triticum*, where premature anthesis vitiates a highly developed crossing mechanism. This is easier to do where the sexes are not separated. 'Fertility' allelomorphs are, for example, known at the incompatibility loci of many plants which normally show this particular outbreeding mechanism. But to reconstitute hermaphrodites from highly developed unisexual species would seem to be more difficult. Hence inbreeding mechanisms are commoner, or at least more obvious, in plants than in animals. The marked sexual dimorphism of animals, developed as an ancillary arrangement for the more effective operation of the outbreeding mechanism, has prevented a return to hermaphroditism in any special cases where inbreeding would be desirable, except by the adoption of extreme devices, as in *Pediculus*.

Gynodiœcy should not be confused with unisexuality in this connexion. It resembles unisexuality in that a proportion of the individuals are female, but differs in that the remainder are hermaphrodite, not male. Clearly the females are at a disadvantage as compared with the hermaphrodites, since they produce but one kind of gamete. Hence gynodiœcy will only survive where the females enjoy some compensating advantage, which is most likely to depend on the outbred nature of their offspring. My colleague Dr. Lewis has shown[3] that the equilibrium proportion of females is directly dependent on the magnitude of this advantage ; so such gynodiœcious species have a ready means of adaptation to change in the hybridity optimum. The proportion of females and so of outbreeding increases with increasing advantage of hybridity and decreases as the advantage of hybridity decreases. Thus gynodiœcy, unlike unisexuality, is a highly adaptable outbreeding mechanism.

[1] Waddington, C. H., "An Introduction to Modern Genetics" (Allen and Unwin, London, 1939).
[2] Altenburg, E., "A Theory of Hermaphroditism", *Amer. Nat.*, 68, 88–91 (1934).
[3] Lewis, D., "The Evolution of Sex in Flowering Plants" (in preparation).
[4] Fisher, R. A., "The Genetical Theory of Natural Selection" (Oxford Univ. Press, 1930).
[5] Muller, H. J., "Some Genetic Aspects of Sex", *Amer. Nat.*, [illegible], 118–38 (1932).
[6] Darlington, C. D., "The Evolution of Genetic Systems" (Cambridge Univ. Press, 1939).

A NATIONAL ATLAS OF BRITAIN

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WITHIN a few days of the appearance in Nature of an article upon the proposed National Atlas[1], an afternoon meeting of the Royal Geographical Society devoted to a discussion of the project was opened by the present writer as chairman of the National Atlas Committee. A verbatim report of the proceedings appears in the current (February) number of the *Geographical Journal*, but since the discussion has already borne practical fruit, and since further arguments for pressing forward with the Atlas have been provided by public events, it appears that a useful purpose will be served by examining the points upon which agreement has been reached.

Prof. Kenneth Mason, chairman of the meeting, recalled that the urgent need for a National Atlas was first realized when the Society was asked to give evidence before the Royal Commission on the Geographical Location of Industry and of the Industrial Population. A portfolio of maps was laid before the Commission, including many that were then drawn for the first time, as, for example, the actual distribution of the industrial (as opposed to the general) population, the pattern of unemployment distribution, and maps showing the relative accessibility by rail of the principal towns of England and Wales in terms of time. Accessibility was a point stressed also by a road map on which was indicated the degree of likelihood of interruption of traffic by snow. This particular map, based though it was on the specialized knowledge of Mr. L. C. W. Bonacina and Mr. Gordon Manley, was rather sceptically received, yet the warnings that it conveyed and the silent advice that it offered have been abundantly justified during the present winter. Indeed, it is not too much to say that had this series of maps been consulted, the selection of centres for the location of reserve stocks of food and fuel, and the choice of boundaries for supply regions, could have been made far more efficiently than has seemingly been the case. The excuse so often made by the responsible authorities that not shortage of supplies but delays and difficulties of distribution are responsible for deprivation and distress is one that demands probing.

It is noteworthy, however, that in their recently published report, the members of the Royal Commission put on record their appreciation of the usefulness of the maps placed before them, and their intention of publishing some of them in a later volume. Should the recommendations of the Commissioners be implemented, then the strength of the arguments for a National Atlas must prove irresistible, for it would provide an obviously useful, even indispensable, adjunct to "Collection and co-ordination of information relating to location of industry, now in the possession of the various government departments", to "Research; and collection of information as to the various natural resources—land, agriculture, amenities, etc.—that may be affected by industrial location", to name but two of the tasks with which the proposed new Central Planning Authority would be charged[2] Moreover, with the National Atlas lying open at the appropriate page, chapter and verse could be given for the "Advice to government, local authorities and industrialists as to problems of location" which the Central Planning Authority would be empowered to offer[2].

It is indeed the case, as the general discussions at the British Association and at the Royal Geographical Society have shown, that, in principle, the plea for a National Atlas finds general acceptance. Nevertheless, an actual Atlas might well fail to achieve usefulness on three or four counts, as, for example, if the information it contained was not entirely reliable or up to date, if the style of the maps was too academic or otherwise unsuited to the general public, if the price of the Atlas put it beyond the reach of all but well-to-do individuals and public bodies.

On all these points the latest discussion has provided information and advice of positive value. In the first instance it is clear that despite the generously offered co-operation of scientists, the Atlas would fail of its object if access could not be secured to official statistics before their publication in Blue-book form. This is essential, not only to avoid a double time-lag, but also because the methods employed in grouping statistics for tabulation often render them unsuitable for plotting on a map. The obvious corollary is that the Atlas must have official status, since such facilities could not be granted to a commercial firm or to private persons.

In respect of the style of the maps, there need be little apprehension, since the long experience and exceptional technical skill of the Royal Geographical Society's drawing-office is generously placed at the Committee's disposal for experimental work. Nevertheless the discussion brought

out an important possibility which had perhaps been overlooked. It was pointed out that the Atlas would undoubtedly be drawn upon frequently for newspaper maps, maps to illustrate articles and lectures, lantern-slides and the like, so that it would be very desirable to bear in mind what would be the appearance of a photostat copy or half-tone block made from any Atlas map: significant detail printed, for example, in blue would, of course, be lost It is here perhaps not irrelevant to note that the secretary of P E P (Political and Economic Planning) in a written reply to a criticism by the writer of the weak and faulty map illustrations in that body's recent memoir on Location of Industry, took up the point of view that economists did not profess competence in cartography and would welcome a reliable source from which illustrative maps could be obtained at will.

The question of how to make a National Atlas accessible at relatively small cost to all those requiring to use it has not been lost sight of, and there has been a general consensus of opinion that the Atlas should be published serially as and when individual maps or groups of maps are completed. The Director General of the Ordnance Survey, speaking from his unrivalled knowledge of the distribution to the public of national maps and plans, expressed the view that the sale of single sheets should be made possible, thus allowing many people to participate cheaply in the benefits the Atlas could afford to their particular interests As another speaker remarked, motorists, salesmen, publicity agents, and many others might require the maps dealing, for example, with transport, amenities, or industrial location, while they would have no interest in maps of fisheries, geology, and the like. On the production side, the sale of single maps might introduce difficulties, but there is no doubt of the importance and the feasibility of the second suggestion coming from Major-General Macleod, namely, that the Atlas should be 'tied' to the series of national plans and surveys (the ordnance maps) by the adoption of the metric grid recommended by the Davidson Committee. By the use of a suitable projection, and by substituting the rectangular lines of the grid for the curved and converging lines of the ordinary graticule, a basic source of difficulty, confusion and error to which the non-geographical map user is prone is at once removed. The position of any point can be exactly determined, and since it is proposed to place an identical grid on all the maps in the National Atlas irrespective of scale, a means of accurate enlargement or reduction is immediately at hand when it is required to make comparisons between maps on different scales. The original plan to make the one to a million scale the basic scale of the Atlas has been seriously challenged on two grounds: that it would make the Atlas as a whole too heavy and bulky to handle, besides the individual sheet being too large for the ordinary desk or table, and that it would require the use of sheets of paper of unusual size which would greatly increase the prime cost. Experiment has proved that a scale of 1 : 1,250,000 for the largest map, that of England and Wales, obviates both these disadvantages, disadvantages which would so repel the public which it is desired to reach, that they must be eliminated at all costs.

It is pleasant to be able to record that funds are in sight for the printing and distribution of numbers of blank base maps on which individual scientists will be invited to plot their contributions. When a sufficient number of such manuscript maps is in hand, it is confidently expected that they will provide in themselves convincing arguments for that official approval and for that public or private financial support which, once secured, will quickly bring a National Atlas into being.

[1] NATURE, 144, 929 (1939).

[2] Report of the Royal Commission on the Distribution of the Industrial Population, 1940, p 203.

THERMODYNAMICS AND THE STRUCTURE OF MATTER*

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THE equilibrium positions of atoms and molecules in condensed phases are the result of an interplay between the forces of repulsion and attraction, and the thermal motions in the substance. This explains why thermodynamic considerations can make important contributions to theories of the structure of matter. Advances in the knowledge of various crystal structures have, on the other hand, led to considerable progress in thermodynamics.

One of the properties of crystals illustrating this statement is the 'lattice energy', which can be defined as the heat of sublimation at absolute zero. The intermolecular forces that lead to

* Based on a course of lectures delivered at the Royal Institution on November 1, 8, 15 and 22.

phenomena such as deviations from the perfect gas equation, capillary and adsorption processes, and the broadening of spectral lines, also lead to the arrangement of all molecules in regular crystal lattices at sufficiently low temperatures. In different crystal lattices, repulsive forces nearly always arise from a common cause, namely, the interpenetration of electron clouds around individual atoms For discussing energetics, crystals are therefore best classified according to the predominant force of attraction. The highest lattice energies are observed when the predominant force is due to covalency (for example, diamond, 135 kcal./mole), or electrovalency (for example, common salt, 181 kcal /mole). A special case of electrovalency arises for metal lattices, in which the negative ions are electrons, the small mass of which leads to special quantum-mechanical forces (for example, sodium, 26 kcal./mole). When the predominant attraction is due to permanent dipoles, the lattice energy is considerably smaller (for example, ammonia, 7 kcal /mole). If hydrogen atoms are present in the crystal, the close approach of the hydrogen atom, forming part of one dipole, to another polar atom, may lead to 'hydrogen bonds'[2]. Finally, the predominant attractive forces may be due to polarization In rare but interesting crystal lattices such as chlorine hydrate, $Cl_2.8H_2O$, and krypton hydrate, $Kr.6H_2O$, the non-polar chlorine and krypton are polarized chiefly by the permanent dipoles of water. Polarization due to zero point motion of the electrons around each atom leads to the much commoner 'dispersion forces', such as predominate in the crystal lattices of inert gases and non-polar hydrocarbons.

In principle, the experimental measurement of lattice energies would involve a determination of the heat of sublimation at any one temperature, followed by extrapolation to absolute zero, using the specific heats of crystal and gas. Lattice energies are, however, seldom known with sufficient accuracy at present to give full significance to this correction. This is partly due to the fact that the vapour pressure of most crystals is too low to permit a direct calorimetric measurement of the heat of sublimation. Numerous indirect determinations depend on two thermodynamic rules:

(1) The Clausius Clapeyron equation, which states that the heat, ΔH, absorbed in any change of phase can be calculated from the volume change, ΔV, and the temperature coefficient of the equilibrium pressure, P, according to the formula $\Delta H = T\Delta V(dP/dT)$;

(2) Hess's Law, which states that the total heat required to proceed from any state A to a state B of the system does not depend on the intermediate route.

The first of these rules is commonly applied in evaluating heats of sublimation from vapour pressure curves. Manometric measurements of the vapour pressure are only possible for a few solids, such as carbon dioxide, but for solids with low vapour pressures the effusion method[3] has been used. A lattice energy of great importance is that of solid carbon, which has been tentatively evaluated from vapour pressure measurements on carbon arcs[4]. The Clausius Clapeyron equation is also used in calculating the lattice energy of polymorphs stable at high pressures[5]

An important example of the use of Hess's Law is presented by ionic lattices, for it is difficult to make direct measurements on changes of the type

$$\underset{\text{solid}}{[\mathrm{NaCl}]} \rightarrow \underset{\text{gas}}{(\mathrm{Na}^+)} + \underset{\text{gas}}{(\mathrm{Cl}^-)} + 181 \text{ kcal}$$

In this example, the heat of sublimation is calculated by summing the successive steps:

$$\underset{\text{solid}}{[\mathrm{NaCl}]} \xrightarrow{+99\text{ kcal}} \underset{\text{solid}}{[\mathrm{Na}]} + \underset{\text{gas}}{\tfrac{1}{2}(\mathrm{Cl}_2)} \xrightarrow{+53\text{ kcal}} \underset{\text{gas}}{(\mathrm{Na})} +$$

$$\underset{\text{gas}}{(\mathrm{Cl})} \xrightarrow{+29\text{ kcal}} \underset{\text{gas}}{(\mathrm{Na}^+)} + \underset{\text{gas}}{(\mathrm{Cl}^-)},$$

for which the heat changes are obtained by calorimetry, vapour pressure determinations, or spectroscopic measurements[6]. An obvious weakness is that errors in the various steps may be cumulative.

Theoretical calculations of lattice energies aim at correlating crystal structures with heats of sublimation, and other properties of the crystal, and have met with considerable success in suitable cases[7].

As the temperature of a crystal lattice rises above 0° K., it acquires various forms of thermal energy. The contribution due to lattice vibrations is best considered separately, before discussing the contribution due to other 'modes of motion'. Among the phenomena which give fairly direct information about the lattice vibrations in various crystal structures are the specific heat, the temperature variation of the intensity of X-ray reflection from various crystal faces, and the thermal expansion.

In the region of temperatures where the law of Dulong and Petit applies, the specific heat is independent of crystal structure. At lower temperatures, the specific heat falls off, and Einstein was the first to calculate the vibrational energy E of crystals in terms of a single frequency ν, characteristic of crystal structure, obtaining the well-known expression, for a crystal of N atoms,

$$E = N\,[h\nu/(e^{h\nu/kT} - 1)].$$

A consideration of even simple models shows, however, that the thermal motions of atoms in a lattice must be interdependent, or 'coupled'. More complete theories of lattice vibrations must take into account the existence of a whole spectrum of

frequencies. In this spectrum there must exist frequencies the wave-length of which is much greater than the lattice spacing, and a maximum frequency the wave-length of which is twice the lattice spacing Owing to the very large number of frequencies (some 18×10^{23} per gram atom) distributed in the vibrational spectrum, some method of approximation must be devised in calculating their contribution to the vibrational energy. A successful approximation was proposed by Debye, who replaced the spectrum of a real crystal by the more easily calculated spectrum of a continuum. The only reference to a discrete lattice structure was introduced by breaking off the spectrum of the continuum at a maximum frequency ν_M Debye's expression for the vibrational energy of a crystal

$$E = 9RT\left(\frac{T}{\theta}\right)^3 \int_0^{\theta/T} \frac{x^3dx}{(e^x-1)}, \quad \text{where } \theta = \frac{h\nu_M}{k},$$

bears about the same relation to experiment as van der Waals' expression does to actual deviations from the perfect gas equation.

The spectrum of real crystals differs from that of Debye's continuum both in showing a wave velocity decreasing with rise in frequency, in place of the constant value assumed for a continuum, and in showing a preferential distribution of frequencies around certain values, in place of the smooth distribution for a continuum. Formulæ have been proposed for the vibrational energy of crystals, involving more than one θ parameter, but since empirical equations automatically gain in flexibility by increasing the number of adjustable parameters, it is not yet possible to assess their theoretical importance[8] in detail.

One disadvantage of specific heat measurements, as a clue to the thermal vibrations of atoms in crystals, is the very fact that a whole series of measurements can be summed in terms of only one parameter—the characteristic temperature θ—which can be related to crystal structure. In principle, much more direct information about the 'mode of motion' of the atoms is obtainable from measurements of the decreased intensity of X-ray reflections with rise in temperature. The intensity of reflection I_T at temperature T from crystal planes with lattice spacing d is given by the expression

$$I_T = I_0 e^{-M},$$

where $M = 4\pi^2 \bar{u}^2/d^2$, I_0 is the intensity at 0° K., and $\bar{u}^2$ is the mean square displacement of the atoms normal to the crystal plane, due to thermal motion. The effect can be demonstrated by a simple model, and has been used in studying thermal vibrations in ionic and metal lattices[9]. It also indicates the zero point motion of atoms in a lattice at 0° K.

The heat motions of the atoms lead not only to a decrease in the intensity of X-ray reflections, but in addition to thermal expansion of the lattice. This is due to the atoms vibrating in a field the law of force of which is non-harmonic. A simple expression relating the coefficient of thermal expansion α with the specific heat C_v, the volume V_0 and the compressibility X_0, is

$$(\alpha V_0)/(C_v X_0) = -d \log \nu_M / d \log V.$$

For most crystal lattices, the maximum frequency ν_M decreases as the volume V increases, and in this case the lattice *expands* with rise in temperature. A correlation of thermal expansion with crystal structure is as yet limited to isolated cases[10].

In crystals containing hydrogen, a special method of studying lattice vibrations involves the replacement of hydrogen by deuterium. This leads to expansions of the lattice in certain cases, and the interpretation is simplified owing to the localization of the change at specific bonds in the crystal[11]

A limited number of crystals have other means of acquiring thermal energy, in addition to vibrations of the lattice. As a rule, these are detected by accurate specific heat determinations. The main features of accurate calorimetry can be summarized under the headings of accurate control of the supply of heat (usually by electrical means), accurate measurement of the rise in temperature of the substance (usually with a resistance thermometer or thermocouple) and accurate control of the heat exchange with the surroundings, obtained by suspending the calorimeter in a high vacuum, and surrounding it with an 'adiabatic' mantle maintained approximately at the temperature of the calorimeter.

When other means of acquiring thermal energy are present in the crystal, they show up on the specific heat curve by a 'hump', that is, a sharp rise in specific heat above the normal vibrational value, followed by an even steeper fall. Other properties of the crystals, such as the magnetic susceptibility, the dielectric constant, and the refractive index may vary rapidly over the same region of temperatures as the specific heat anomaly, and can be used as additional means of studying the phenomena, or for demonstration in a lecture.

Typical examples are the transformation in nickel (ferromagnetic-paramagnetic), the change from ordered to disordered alloy in β-brass, and the (presumed) rotation of methane and other hydrocarbons in their crystal lattices above a certain temperature, though many other cases are known. The almost catastrophic intake of thermal energy in all these cases is due to a co-operative effect between neighbouring molecules, which may be illustrated by reference to the

rotation of methane. The crystal forces restraining rotation are due to the interaction of neighbouring molecules, which maintain preferred orientations in the lattice at sufficiently low temperatures. The thermal energy required by isolated molecules to overcome these restraining forces, and to rotate freely, may be quite large, but once they are rotating their restraint on their neighbours is lessened. Further molecules will thus have to acquire less thermal energy in order to rotate freely; the transition to complete rotation has analogies with an autocatalytic process[12]. This explanation is substantiated by experiments on the specific heat anomaly of methane with increasing amounts of krypton in solid solution[13]. The krypton atoms lessen the mutual restraint of neighbouring methane molecules, acting as lubricants, with the result that the abnormal intake of heat becomes less and less catastrophic.

The problems and results of calorimetry are of importance both for theories of crystal structure, and also in the calculation of equilibrium constants. The entropy of a solid can be written

$$S = S_0 + \int C_p \, dT/T,$$

and for a perfect gas, $S = S_0' + \int C_p \, dT/T - R \log_e P$, where S_0, S_0' are the (arbitrary) entropy constants. In order to calculate equilibrium constants solely from heats of reaction and specific heats, that is, from calorimetric measurements, it is necessary to evaluate these entropy constants. The solution proposed by the Nernst heat theorem can be stated in such a way that S_0 for solids is zero, so that S_0' for gases can be determined from the vapour pressure curve. Cases are known, however, where the assumption $S_0 = 0$ for the crystal does not agree with experiment. The simplest example arises in crystals of molecules such as NO, CO, N_2O, in which the molecules appear to have random orientations below the lowest temperature of measurement[14]. As a result, the experimental evaluation of the integral $S = \int C_p dT/T$ misses out a specific heat 'anomaly', merely because of the experimental difficulty in making measurements at still lower temperatures. The constant S_0 appears to be greater than zero, in compensation.

Interpretation of these and of other departures from the Nernst heat theorem is greatly facilitated by a knowledge of the crystal structures, and presents one more illustration of the interdependence of thermodynamics and theories of the structure of matter.

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OBITUARIES

Sir Charles Hagbert Wright

SIR CHARLES HAGBERT WRIGHT, who died on March 7 last at seventy-seven years of age, was a notable librarian, a man of letters and a characteristic London figure. He was a man of strong personality tempered with kindness. To describe him as a born librarian may be thought to do him less than justice. He possessed that logic of mind, energy of character, organizing ability and power of handling men which are as necessary to the librarian of a great library as to the man of business. To these qualities he added a wide knowledge of languages and a love of literature.

Sir Charles's association with the London Library began some forty-six years ago, when the library was much smaller than it is to-day. His wide circle of friends enabled him to acquire valuable donations of books and to collect necessary funds for new buildings in 1896 and for subsequent extensions. He realised the essential part a large library has to play in the advancement of learning and was successful in inculcating in his staff the feeling that they too were concerned in this work.

From such a library as the London Library long arms stretch out, embracing the globe and gathering continually material for the enrichment of its stores of information. In his extensive travels Sir Charles made and improved such contacts, without which no great library can function effectually. Nor does a sometimes insufficiently appreciative public always realize that the services rendered by such a library depend on the smooth running of a train of mechanism comprising many wheels. I well remember with what interest Sir Charles explained to me, many years ago, the details of the hidden silent machinery in the London Library, much of which he had himself designed.

Russian subjects claimed the first place in Sir Charles's literary interests. Yet his book "Nicholas

Fabri de Peiresc", published in 1926, came within the field of science. As he said, "Here we have the phenomenon of an antiquarian who was equally engrossed in medicine and surgery, in astronomy and scientific research". The combination of naturalist and antiquary in his uncle, Edward P. Wright, may have given him a lead in that direction. Through his brother, Sir Almroth Wright, the celebrated pathologist, Sir Charles had many contacts with the scientific world, and he always endeavoured that the committee of the London Library should include scientific men. Alfred Russel Wallace and Sir Archibald Geikie were among the well-known men of science who served in this capacity in his time.

Although the London Library is essentially a library of general scope, its extent implies that it should contain valuable collections of scientific works. Sir Charles endeavoured especially to secure whatever he thought would be of value to future historians of science, and the Library's extensive representation in the history of science and of medicine is of special value to scientific men. S. C. BRADFORD.

Prof. S. Lees

PROF. SAMUEL LEES held the Chance chair of mechanical engineering at the University of Birmingham from October 1, 1931, until his death on January 27 last. The son of Alderman S. H. Lees, of Salford, he was born in that town on August 26, 1885. He received his early engineering training at Ferranti, Ltd., of Hollinwood and Charles Churchill and Co., Ltd. (afterwards The Churchill Machine Tool Co. Ltd.), of Broadheath, Manchester. Whilst a student of the Manchester School of Technology he gained a Whitworth Exhibition in 1905 and a Whitworth Scholarship in 1906. At about this time he won a prize of £200, open to technical students generally of Great Britain, offered by Messrs. George Newnes, Ltd., in connexion with their periodical *Technics*.

After proceeding to Cambridge he took his B.A. in 1909, and later his M.A. He was awarded the Rayleigh and John Winbolt Prizes in 1911, became Hutchinson Student, and was elected in 1912 a fellow of St. John's College. In 1913 he was appointed reader in applied thermodynamics in the Faculty of Technology of the University of Manchester.

From 1915 until 1918 Lees was with the Navy, first as engineer lieutenant and afterwards engineer lieutenant commander. Most of his war service was spent on research work at Portsmouth Dockyard and concluded with a short spell at Farnborough. After the War he returned to Manchester. From 1919 until 1929 he was Hopkinson lecturer in thermodynamics at the University of Cambridge, and for a number of years director of engineering studies at St. John's College. He left Cambridge to become consultant mechanical engineer to Silica Gel, Ltd., and spent some time in Baltimore, U.S.A., on problems concerning the application of silica-gel to industrial uses.

After two years in industry, Lees returned to academic life to take the chair at Birmingham. Here he reorganized the research work of the Department of Mechanical Engineering and was engaged in the investigation of several problems having a bearing upon air-conditioning and upon internal combustion engine theory and practice. These included the air-cooling of metal surfaces, heat transmission through metals and loose aggregates, the study of delay-period phenomena in compression ignition engines, catalytic and other methods of improving combustion in engines of this type, exhaust noise in internal combustion engines, electrical methods of indicating high-speed engines and the flow of gases through orifices and nozzles with the view of correlating experimental work with dimensional theory. Some of these researches were in an incomplete but advanced state at the time of his death.

Prof. Lees was a man of unassuming disposition and incapable of self-advertisement. A first-class teacher, a profound thinker on his subjects, helpful to the point of self-sacrifice to all with whom he was associated, his early death at the age of fifty-four years is a severe blow to the University of Birmingham and to his colleagues, his staff and his students, especially foreign students, who had an affectionate regard for him. He leaves a widow and two sons.

WE regret to announce the following deaths:

Prof. Alfred Bielschowsky, at Hanover, New Hampshire, U.S.A., for many years professor of ophthalmology at Marsburg and Breslau, and a leading authority on motor disturbances of the eye and the physiology and pathology of space sense, aged sixty-seven years.

Prof. Edouard Branly, the pioneer in radio communication, on March 25, aged ninety-five years.

Mr. E. T. Cottingham, the well-known maker of scientific time-recorders, on March 20, aged seventy years.

Sir Patrick Laidlaw, F.R.S., pathologist to the Medical Research Council, deputy director of the National Institute for Medical Research, on March 20, aged fifty-eight years.

Mr. W. H. Lovegrove, formerly conservator of forests, Kashmir, on January 25, aged seventy-two years.

Prof. E. Mapother, professor of clinical psychiatry in the University of London, formerly medical superintendent of Maudsley Hospital, on March 20, aged fifty-eight years.

Prof. D. S. Margoliouth, F.B.A., Laudian professor of Arabic in the University of Oxford during 1889–1937, on March 22, aged eighty-one years.

Prof. W. S. Miller, emeritus professor of anatomy in the University of Wisconsin, on December 26, aged eighty-one years.

Prof. Michael Siedlecki, professor of zoology in the University of Cracow.

Dr. Werner Spalteholz, emeritus professor of anatomy in the University of Leipzig, on January 12, aged seventy-nine years.

NATURE

SUPPLEMENT

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SHORT REVIEWS

Anthropology of Archaeology

Aboriginal Woman, Sacred and Profane
By Dr. Phyllis M. Kaberry. Pp. xxxii+294+8 plates. (London: George Routledge & Sons, Ltd., 1939.) 15*s*. net.

DR. KABERRY'S observations among the aborigines of north-west Australia, of which certain of the results are given in this volume, mark a new departure in the study of the primitive peoples of that continent. While it is no new thing for women to enter the field of anthropological investigation with the specific object of illuminating the sphere of the woman among backward people—that is a matter of the anthropological history of more than a generation—and Australian records include the names of more than one notable woman observer, Dr. Kaberry has approached the problem of the tribal woman from what in Australia is a new point of view. Hitherto, both in form and content, tribal life and organization have been assumed tacitly to be mainly the province of the male members of the group, with the female as an appendage or adjunct of the male, performing, it is true, certain functions essential to the continuance of the group and to the life of the individual, but otherwise of little significance. Here in Dr. Kaberry's detailed record of the results of observations carried out among various tribes in 1934 and 1935–36 is set out the evidence of how far the female members can be regarded as socially individuals, and how far the functions attributable to them pass beyond the 'profane' in tribal life and enter into the 'sacred' province, in which the male has hitherto monopolized the centre of the picture in anthropological investigation.

If it be said that the results of Dr. Kaberry's investigations enlarge considerably the conception of woman's status and function in the Australian tribe, that need be no matter for surprise, at least for many who have regarded previous records from this aspect with some reserve. She has, however, gone considerably beyond most of her predecessors by transcending the form of tribal institutions and extending her inquiry to 'cases'—in other words, by finding out how far these institutions work, how far they are elastic, so as to admit alternative modes of behaviour, and how far they are flouted by the conduct of individuals. As a result, the aboriginal woman emerges not merely as an anthropological specimen, but also as a human being and an individual—essentially of the feminine order.

Herbert Spencer Betrayed
With some account of the repudiation of the "Descriptive Sociology" by his Trustees. By Alfred W. Tillett. Pp. x+68. (London: P. S. King & Son, Ltd., 1939.) 4*s*. 6*d*. net.

MR. TILLETT vigorously attacks the trustees of Herbert Spencer's will on the grounds: (1) that while the terms of the will required his estate to be applied to completing the publication of "Descriptive Sociology", which was uncompleted on Spencer's death, they acted *ultra vires* in publishing Dr. Rumney's "Herbert Spencer, Sociologist", in which Spencer as philosopher and man is vilified; and (2) that they determined the Trust and distributed the balance of the fund among the residuary legatees before the work, for which the trust was created, had been completed.

Mr. Tillett, though advised to the contrary, still hopes that it will be possible to obtain a judicial pronouncement on the position he has taken up; and it is therefore undesirable to express any opinion here, even if the case were not one involving difficulties of interpretation, legal and other. There is no doubt that in such matters open accusation is better than underground insinuation. It may be pointed out, however, that the trustees had exercised every care in becoming discharged of their trust. Not only had the Court already varied the terms of the will to meet changed conditions, but also the opinion of the Attorney General was sought before the trustees took final action. With the legal position of the trustees thus clarified, in view of recent development in sociological studies, further expenditure in this direction seemed to be largely waste.

Biology

Keys to the Phyla of Organisms, including Keys to the Orders of the Plant Kingdom
By Fred A. Barkley. Pp iv + 40. (Missoula, Montana: Associated Student's Store, 1939.) 75 cents.

IN this pamphlet of thirty-nine pages, Dr. Barkley gives a series of dichotomous keys referring chiefly to the orders of the various 'plant' phyla. The keys have been drawn up to meet the needs of the author's class in plant morphology and have been so constructed as to reflect in large part the views of outstanding authors regarding certain groups. They are intended to give also a more or less comparative treatment of the ordinal category under the various phyla.

Students who have a general knowledge of systematic botany and zoology will find it useful first to get a bird's-eye view of the classification employed by referring to the outline given on pp 26–27. In this outline the sequence of phyla, classes and orders follows that of the keys, and only in broad outline, therefore, can the classification be regarded as an expression of relationships. Organisms as a whole are divided into four kingdoms: Monera, Protista, Phyta and Zooea Cohn's old group 'Schizophyta' is retained as a division of the Monera and serves to include Cyanophyceæ, Spirochætæ and Schizomycetes An unusually wide interpretation is given to the Protista, since this kingdom is made to include not only Protozoa and Parazoa but also all the organisms commonly classed as Algæ and Fungi. Bryophytes head the list of the phyla placed in the kingdom Phyta and are followed in turn by Pteridophytes and Spermatophytes, the last phylum of which—the Anthophyta—includes the large number of orders into which Dicotyledons and Monocotyledons are divided. Apart from an occasional change of name and a different sequence, the orders of flowering plants are the same as those proposed by Hutchinson in "The Families of Flowering Plants". In the keys to the orders a great deal of detailed observation is compressed, much of which will not prove easy reading to the elementary student, but the inclusion of a useful glossary (pp. 29–38) will help to get over the difficulty. J. R. M.

Bibliography of the Larvæ of Decapod Crustacea
By Dr. Robert Gurney. (Ray Society, Vol. 125, for the Year 1937.) Pp. vii + 123 (London: Bernard Quaritch, Ltd., 1939.) 12*s.* 6*d.*

THE preparation of bibliographies is often a thankless task, although few would deny their importance. The present example covers the literature of the larvæ of Decapod Crustacea (excluding the Euphausiacea) up to May 1939. It comprises three sections—an alphabetical list of authors, a classified catalogue in which the literature is arranged zoologically, and an index to genera. Some eight hundred titles are recorded.

We have tested the work here and there both as regards completeness and accuracy, and have little criticism to offer. Every bibliographer knows that completeness is unattainable and even accuracy is curiously difficult to achieve. Nevertheless, we have noted only the following errors and omissions: the paper by Audouin and M. Edwards, 1828, on the nervous system of Phyllosoma, Dalyell's "Powers of the Creator", vol. 1, 1851, containing observations on Decapod larvæ, Leach's earlier article on Megalopa of 1814, and Leeuwenhoek's letters of 1686 and 1700 on the development of Crangon are omitted. Crawford and Smidt's paper on Panulirus should be dated 1922 and for "Larvæ, p. 9" read "Larva, p. 309"; Milne Edwards is not a hyphenated name and should be catalogued under Edwards; Hornell's papers on Squilla and Scyllarus were reprinted in a volume of "Microscopical Studies" in 1901; the reference to Linnæus should be to the twelfth edition, Holmiæ, 1767; and Slabber's figure of the zoea larva should be dated 1769.

Dr. Gurney is to be congratulated on the completion of a valuable piece of bibliographical research and the Ray Society for having undertaken its publication. F. J. C.

Basic Methods for Experiments on Eggs of Marine Animals
By Ernest Everett Just. Pp. x + 89. (London: The Technical Press, Ltd., 1939.) 6*s.* net.

THE methods used in experimental investigations of the eggs and spermatozoa of marine invertebrates depend very strongly on the adherence to some general rules. Some of these are set out in this little volume, which should be useful for beginners in the field of experimental embryology, and for the specialist whose work demands individual extension of methods. Whilst the techniques described apply to the gametes of American marine species, they are sufficiently general to be applicable also to the gametes of the same species, and to those of closely related species, in European waters. Dr. Just has developed his methods over a period of twenty-five years, so that the issue of this book was to be expected as a necessary supplement to his recently issued "Biology of the Cell Surface". In no wise can it be claimed to be a catalogue of all methods in use, but, nevertheless, the methods described, and especially those relating to preparations of fixed tissues, should be of value to cytologists.

Notes on the Genus Dioscorea in the Belgian Congo
By I. H. Burkill. (Extrait du *Bulletin du Jardin botanique de l'Etat,* Vol. 15.) Pp. 48. (Bruxelles: Jardin botanique de l'Etat, 1939.)

THIS important study is by one of the authors of the revision of the Eastern Dioscoreas. It will prove invaluable in compiling any general account of the genus in Africa. Twenty-three species are recorded with several varieties for some of them; two of the species are here described for the first time. These species of the Congo are attributed to six sections of which four twist to the left. A definition of each section is given, and a key to the species is provided for each plurispecific section. A full history and synonymy of every species will be found, together

with a comprehensive statement of the known collectors and its distribution within and without the Belgian Congo. Many interesting notes are furnished on the depth below ground-level at which the tubers are seated, on their edibility and method of preparation for food; poisonous properties; bulbil production and self-protective measures. Of peculiar interest and value are the discussions on the origin, evolution and "ennoblement" (improvement and refinement by selective cultivation) of the most-prized yams. It is indicated that some of the problems involved can only be solved in the field and that "the paper is intended to direct all who are able to study the Congo Dioscoreas alive to points worthy of their particular attention".

A debt of gratitude is due to Mr. Burkill for collating much valuable information from many sources and adding the results of his own patient and extensive research, both in the herbarium and in the field, which has cleared up several obscurities.

Chemistry

Perkin and Kipping's Organic Chemistry
By Prof. F. Stanley Kipping and Dr. F Barry Kipping. Part 3. Revised edition. Pp. viii+615-1030. (London and Edinburgh: W. & R. Chambers, Ltd., 1939.) 9s.

Of late years there has been a marked dearth of works dealing with advanced organic chemistry in a manner suitable for students reading for an honours degree in chemistry. Part 3 of "Perkin and Kipping's Organic Chemistry" can be recommended with confidence to such students and also to research workers. It is a handy volume comprising some four hundred pages and yet not too bulky for an ordinary pocket. Its twenty-three chapters afford concise and up-to-date treatments of a surprisingly large number of subjects of current importance in organic chemistry, including physical properties, isomerism (four chapters) and isomeric change, carbohydrates (two chapters), terpenes and related groups (three chapters), carotenoids, anthocyanins, metallic ketyls, aromatic substitution, etc. The chapter on heterocyclic compounds (12 pp.) is limited to azoles, diazines and vitamin B. In this new edition the configurational formulæ of the sugars (which gave rise to difficulties as expressed in the first edition) have been revised, and two new chapters have been added: one of these deals with the theory of resonance (12 pp.) and the other with sterols, bile acids and other steroids (21 pp.). The text and formulæ are neatly printed, and there is a good index.

A Text-Book of Quantitative Inorganic Analysis
Theory and Practice. By Dr. Arthur I. Vogel. Pp. xix+856. (London, New York and Toronto: Longmans, Green & Co., Ltd., 1939.) 18s.

As would be expected of a teacher with wide experience of students of all grades, Dr. Vogel has produced in this book a notable contribution to chemical literature and a valuable guide to those engaged in chemical study.

The book is divided into six chapters dealing respectively with the theoretical basis of quantitative analysis, the experimental technique required, volumetric, gravimetric, colorimetric and gas analyses. In each of these chapters, the reader will discover a wealth of detail not only of the more classical methods of analysis but also of the most up-to-date modifications and discoveries. Most of the new methods have been tried out in the author's own laboratory. In addition, there is a comprehensive appendix containing chemical data which will be of great value to practising analytical chemists, whilst teachers of chemistry will find much interest in the suggested schemes of study for various examinations.

Dr. Vogel's book can be confidently recommended to students of all grades as a sound, up-to-date and accurate treatise on methods of analysis, a study of which will be amply sufficient for all examinations up to the honours degree. The book should also be on the bookshelf of all industrial analytical chemists, who will find it a useful reference book in modern methods of analysis.

Physikalische Methoden der analytischen Chemie
Herausgegeben von W. Bottger. Teil 3: Chromatographie, Verdampfungsanalyse, Spektroskopie, Konduktometrie, Photoelektrometrie, Polarographie, Potentiometrie. Pp. xx+836. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 65 gold marks.

This book is more than merely a description of the application of a number of physical methods to analytical chemistry. This is due to the fact that the editors have taken a very broad view of what constitutes analytical chemistry. The consequence is that much pure physical chemistry finds its way into the volume. There is, of course, emphasis on experimental technique.

The main subjects treated are chromatographic analysis, analysis by fractional evaporation, spectroscopic analysis, photometric methods and analysis by conductometric, polarographic and potentiometric methods. It is absolutely impossible in a short review even to give a list of the contents, for they are so varied. The aim of each contributor is not only to describe methods but also to give enough practical details so that the reader may conduct the experiments with success. Moreover, each section of the book is copiously provided with references to recent literature. For example, the section on potentiometric methods includes at least one thousand references.

There is much in this book to interest physical chemists as well as those who wish to find the most useful analytical technique for any given problem. The index and table of contents make the search among such a mass of material an easy business. The volume is well printed and bound but is rather expensive.

H. W. M.

ENGINEERING

Electricity Meters and Meter Testing
By G. W. Stubbings. (Monographs on Electrical Engineering, Vol. 6.) Pp. x+216. (London: Chapman & Hall, Ltd., 1939.) 12*s*. 6*d*. net.

IT is only of recent years that the question of the metering of electric supply has been seriously tackled. The question itself is a most difficult one, and the introduction of tariffs and the theory of statistics, and attempting an impossible accuracy, have certainly not made it easier. The easiest way is to put a sub-standard wattmeter in series with the consumer's meter for a day or a fortnight and then read them both simultaneously. If they both read the same then everyone is satisfied. But the meter reader who has had his own sub-standard meter tested at a standardizing institution and knows the curve of error of his own meter sometimes wonders whether it is correct or not. The present limits for consumers' meters as described in the Electricity Supply (Meters) Act of 1936 are $2\frac{1}{2}$ per cent plus or $3\frac{1}{2}$ per cent minus. That is, the permissible error when the meter is going fast is less than when it is going slow. The test of the meter at no load should always be taken, and if it is rotating then it is a long and costly business to find out what is wrong.

From what we have said it will be seen that it is no easy matter to meter an electric supply. Even the expert who is thoroughly familiar with the apparatus used in an electrical laboratory, or even in a meter-testing house, will find that there are numerous problems inseparable from the everyday work of the meter-tester that are not yet satisfactorily solved. For example, there are errors due to bearing friction, fluid friction, frequency, phase, self-braking, temperature, varying load, voltage variation, wave distortion, official limits, tariffs, etc. It is no easy task to keep in good working order hundreds of thousands of little meters, and the task of the superintendent of a meter-testing department is no sinecure.

The author of this book has a thorough knowledge of the difficulties in the way in Great Britain and knows well the difficulties in many cases of treating equitably suppliers and consumers. He includes an appendix giving the titles of many recent books on the subject and also of technical papers. The reader will find that it is no easy matter to become a meter expert.

Elements of Practical Aerodynamics
By Prof. Bradley Jones. Second edition. Pp. viii+436. (New York: John Wiley and Sons, Inc.; London: Chapman & Hall, Ltd., 1939.) 18*s*. 6*d*. net.

THIS is the second edition of an American book, the first of which was reviewed in NATURE of July 31, 1937. It is an exceedingly lucid and simply written students' text-book, that should prove useful to engineers or physicists commencing the study of aeronautics. A feature of the book is the large number of worked examples in the text, and further exercises at the end of each chapter. These are carefully graded and form an admirable addition to the book; one which might well be added to most English books on this subject of the same standard.

The subject-matter has been brought up to date, and most of the more modern developments mentioned in a general way. Some of this later work is superficial, but not unduly so remembering that it is an elementary and necessarily restricted work. Among these are discussions on tapered monoplane wings, methods of working out low drag contours, performance calculations including approximate rapid prediction methods, problems of control and stability from the practical but not the mathematical point of view, and details of the more modern aerofoils (those more popular in the United States). A chapter on "Auxiliary Lift Devices"—about three pages—is disappointing, and makes no attempt to explain the many variations of the allied problems of speed range and control that arise from the use of these. Worked examples, as in some of the other chapters, would have been particularly valuable here.

As in the first edition, the book ends with chapters on such subjects as materials, meteorology, instruments, etc. These are accurate so far as they go; but are so short as to be of little use. They are illogical in a book with this title, and it seems a pity that the author did not confine himself to aerodynamics, and give fuller discussions upon the aspects of this in the relevant chapters.

FORESTRY

Principles of Forest Entomology
By Prof. Samuel Alexander Graham. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xvi+410. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 24*s*.

WE welcome the appearance, after a decade, of a second edition of this well-known handbook. Considerable advances have been made in that period as regards our knowledge of the principles of forest entomology. The European pine sawfly, for example, has become prominent as a forest pest in that short period. Certain chapters of the book have been almost wholly rewritten: others have been revised, and the bibliography has been brought up-to date.

Elementary Forest Mensuration
By M. R. K. Jerram; with a Chapter on The Measurement of Forests, by R. Bourne. Pp. x+124. (London: Thomas Murby & Co., 1939.) 8*s*. 6*d*. net.

IN this little book, Mr. M. R. K. Jerram states that the word 'elementary' has been prefixed to the title as the work is intended chiefly for the professional forester rather than research specialist, and he has been guided in his method of treatment of the subject by this factor. For the greater number of professional foresters, either in being or still in the student stage, forest mensuration is a practical part of their work—the higher branches of the subject are required by the research worker alone.

Still, the author gives an account of a few of the less well-known methods in use by research workers. Otherwise in his treatment of the subject Mr. Jerram deviates but slightly from the ordinary lines, which are not capable of much variation. An interesting chapter on "The Measurement of Forests" is contributed by Mr. R. Bourne, late lecturer in forestry at Oxford University. The book may be recommended as a useful text-book.

GEOLOGY

Geology of London and South-East England
By G. M. Davies. Pp. viii + 198 + 4 plates. (London: Thomas Murby & Co., 1939). 7*s*. 6*d*. net.

IN a recent broadcast on "Science in Wartime", Sir Albert Seward, then president of the British Association, commended to his listeners the interest and satisfaction that are to be gained from dipping into the history of past ages on the earth, and he chose as one of his examples the study of the London Clay. For those who, for cultural or utilitarian ends, would like to follow up this suggestion in the still rather heavily populated area of south-eastern England (and are prepared to take the risk of being arrested as spies in the course of their field studies), the book under notice appears at the opportune moment.

Instead of adopting the usual historical method of treatment—from ancient to modern—the author reverses the process in the belief that people will find it easier to work back from the known present to the unknown past. His treatment therefore opens with "made ground" and recent deposits, and passes on to the records of early man, ancient river deposits, the relics of the Ice Age, and so to the Tertiary rocks of the London and Hampshire Basins, the Chalk, and finally the pre-Chalk formations that are included within the area from the Fens to Oxford.

Other interesting subjects treated in a simple way are the Palæozoic floor under the east of England, the water-supply, the building-stones of London, and the development of scenery. Abundant photographs, text-figures of characteristic fossils, geological sections, sketch-maps and judiciously selected references to relevant publications (for those who wish to pursue the subject further) enhance the usefulness of the book.

Die Entwicklung der Kontinente und ihrer Lebewelt
Ein Beitrag zur vergleichenden Erdgeschichte. Von Prof. Dr. Theodor Arldt. Zweite, vollständig neubearbeitete und erweiterte Auflage. Band 1. Pp. xviii + 449–1005. (Berlin: Gebrüder Borntraeger, 1938.) 44 gold marks.

THE first edition of Prof. Arldt's great work appeared in 1907. Since that time, great advances have been made in palæogeography, biogeography and related sciences. Further, a complete new theory of the origin of continents and oceans has burst upon the geological world. This second edition is therefore a greatly expanded one, the first volume of it alone amounting to a thousand pages. The first part of this volume, issued in 1936, was noticed in NATURE of May 29, 1937, pp. 902–3. In it the question of the permanence of the earth's major features was raised, and the answer is not yet forthcoming even in the thousand pages of the present volume. It seems likely, however, that land-connexions between continental masses will be approved, but for the final answer we must await the second volume, which will contain the geological and cosmological findings.

In these thousand pages, then, we have a very detailed examination of the distribution of present and past life. So far as this colossal mass of information can be handled, it is summarized in a series of tables and charts. The last thirty pages of the volume deal with a few general topics, such as the geological distribution, the regions and the origin of life. By the ordinary geologist, who appreciates at least the quantity of the evidence produced by Arldt, the geological verdict will be awaited with interest.

MATHEMATICS AND ASTRONOMY

Modern Machine Calculation with the Facit Calculating Machine Model Lx
By H. Sabielny. Translated and revised by Dr. L. J. Comrie and Dr. H. O. Hartley. Pp. 74. (London: The Scientific Computing Service, Ltd., 1939.) 5*s*.

APART from the many excellent brochures issued by the leading makers of modern calculating machines, there is very little scientific literature on the subject. This is somewhat strange in view of the increasing use made of these machines in present-day business houses, coupled with the fact that probably the first adding machine was exhibited so early as 1884. The present manual will therefore be welcomed by all who wish to know something authentic about modern machine calculation. Mr. Sabielny's original text was published by Aktiebolaget Facit, Atvidaberg, Sweden, by whom the Scientific Computing Service, Ltd., under the direction of Dr. L. J. Comrie, was requested to prepare an edition suitable for use in English-speaking countries. Whilst the text deals particularly with the Facit Model Lx, much of it is applicable generally to other machines of similar type.

There are four parts dealing respectively with fundamental principles, examples of practical calculations, British currency and tables. The translators have followed the original text on the whole, although certain sections have had to be either cut out or modified. They have also incorporated some important new matter. Part 2, for example, on British currency, weights and measures, is new, whilst the very practical sections on 'short-cutting' in multiplication and division have been extended and a new method given for carrying out the rule of three with one operation without any embarrassment from complements.

The manual has been excellently prepared by the translators and should provide a very practical and scientific guide to the use of the modern calculating machine. F. G. W. B.

(1) Annuaire pour l'an 1940
Publié par le Bureau des Longitudes. Avec des Notices scientifiques. Pp. viii+550+A16+B26+C54. (Paris: Gauthier-Villars, 1940.) 25 francs.

(2) The Observer's Handbook for 1940
(Thirty-second Year of Publication.) Pp. 80. (Toronto: Royal Astronomical Society of Canada, 1939.)

(1) AMONGST the various handbooks published each year mention may be made of the "Annuaire", published by the French Bureau of Longitudes, and "The Observer's Handbook" of the Royal Astronomical Society of Canada The former has a long history, being first published in 1795, when it contained about eighty pages The present comprehensive volume contains 550 pages besides an appendix. Its contents are grouped under the following headings: (1) Calendar for 1940 including astronomical data, tide predictions, etc., (2) Earth—geodesy, meteorology, terrestrial magnetism, time determination; (3) Astronomy—star charts, minor planets, comets, stellar spectra, etc.; (4) Units of measurement; (5) Physical and chemical data. Two special articles are appended: "L'Espace Interstellaire", by M. Chas. Fabry (being the George Darwin Lecture of the Royal Astronomical Society for 1938), and "Le Bureau Internationale de l'Heure", by M. A. Lambert.

(2) "The Observer's Handbook" is purely an astronomical handbook intended more especially for the use of the non-professional. Besides providing a journal of astronomical events from day to day (datum, 75th meridian civil time), there are several useful tables. One of these gives the principal facts regarding 259 stars brighter than apparent magnitude 3·51. Another gives the position and type of the star clusters and nebulæ contained in Messier's catalogue compiled in 1781. A rough chart directs attention to the remarkable grouping of bright planets which occurred on February 28 (see also NATURE, January 27, p. 146). The transit of Mercury across the sun's disk on November 11–12 receives notice as it will be partly visible in Canada,.

Structure of Algebras
By Prof. A. Adrian Albert (American Mathematical Society, Colloquium Publications, Vol. 24.) Pp. xi+210 (New York: American Mathematical Society, 1939.) 4 dollars

NOT only the contents, but even the title of this book may puzzle many good mathematicians of the older school Algebra seemed to be a stereotyped subject which started with substitution, addition, subtraction, multiplication and division, had a great deal about equations, progressions, the binomial, exponential and logarithmic theorems, and then, after some chapters on miscellaneous topics, concluded with determinants and the theory of equations. There were a few pages headed the "Fundamental Laws of Algebra", which were generally felt to be an unnecessary statement of the obvious. At one time invariants came into fashion, and were spoken of as the "Modern Higher Algebra".

Now recently books have appeared having scarcely anything in common with older books except their titles. In Prof. Albert's "Modern Higher Algebra" (Cambridge University Press, 1938) the subjects dealt with are groups, rings, integral domains, fields and matrices. The subject of matrices, so important in quantum mechanics and factor analysis, is here taken as the starting point for the discussion of abstract entities satisfying the same laws as certain matrices. These entities are known as linear associative algebras. In the book under review a more advanced treatment of these algebras is given, including recent advances due to R. Brauer, H Hasse, E. Noether, and the author himself.

Medical Sciences

Bergey's Manual of Determinative Bacteriology
A Key for the Identification of Organisms of the Class Schizomycetes. By David H. Bergey, Robert S. Breed, E. G. D. Murray and A. Parker Hitchens. Fifth edition. Pp. xi+1032. (London: Baillière, Tindall & Cox, 1939.) 45s.

IN the sixteen years that have elapsed since the first publication of Bergey's "Manual" the work has undergone considerable change and amplification; many of the mistakes that detracted from the earlier editions have been rectified and the present edition, under its capable board of editors, shows a marked advance on its predecessors.

The assistance of experts has been made use of in the revision of certain groups—particularly in the realm of serology—and for the first time attention is directed to the serological grouping and typing of the hæmolytic streptococci and to the work of the Salmonella Sub-committee of the Nomenclature Committee of the International Association of Microbiologists on the taxonomy and classification of the genus *Salmonella*. In the latter connexion be it observed, however, that the organism of typhoid fever is still placed in the genus *Eberthella* instead of in the genus *Salmonella*, where by virtue of its serological characters it most certainly belongs, and that notwithstanding the serological identity of *Salmonella pullorum* and *Salmonella gallinarum* the latter is taken out of the genus *Salmonella* and placed in the genus *Shigella*, along with the dysentery bacteria. Furthermore, no mention is made of the significant serological relationship of the organism of tularæmia with the members of the genus *Brucella* and it is relegated to the genus *Pasteurella* on purely negative characters. The curious statement is made, moreover, that this widespread disease is only known in North America.

Strange omissions are still noticeable: one searches in vain for description of the organisms of pleuro-pneumonia and contagious agalactia and the other members of the group—this in spite of a considerable and growing literature on the subject. No doubt these and other questions will be considered at some future date and necessary action taken by the recently appointed Judicial Commission of the Nomenclature Committee of the I.A.M., of which the editor-in-chief of the "Manual" is one of the joint-secretaries.

William B. Wherry, Bacteriologist

By Martin Fischer. Pp. x + 293. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall & Cox, 1938.) 27*s*.

THIS is in its way a quite unique biography of a bacteriologist, W. Buchanan Wherry (1875–1936), professor of bacteriology and hygiene in the Cincinnati College of Medicine, by an author, Prof Martin H. Fischer, who was his subject's colleague and lifelong friend and has already earned for himself distinction in biographical literature. Though Wherry's services to bacteriology can scarcely be said to have been of an outstanding nature—perhaps his most important contributions were his recognition, practically simultaneously with McCoy, of bubonic plague among the ground squirrels of California and his isolation for the first time of *B. tularense* from a human case of tularæmia (Wherry and Lamb, 1914) – he had acquired in the course of his career as a bacteriologist in Manila, California and Mexico a very varied experience of tropical diseases and their methods of study.

Wherry must undoubtedly have had a great genius for friendship, and Fischer's tribute to his friend's life-work, based as it is on the numerous letters that passed between them since college days, and written in the very glowing terms employed by some American biographers of scientific men both living and dead, is sure to exert a powerful popular appeal. Perhaps the most interesting portions of the book are those that recount the life-story of Wherry's father, a missionary in India of strictest orthodoxy, and of his mother, sisters and brother. Letters that passed between the parents and the son—for they were all carefully preserved—throw a penetrating light on the daily doings of an Indian missionary and the financial struggles that seemed always to be pressing For these revelations alone the book deserves a wide audience. It is beautifully produced—it represents in fact the last word in typography—and numerous excellent photographs relieve its 300 pages of text.

The Anaerobic Bacteria and their Activities in Nature and Disease

A Subject Bibliography. By Elizabeth McCoy and L. S. McClung. Vol. 1: Chronological Author Index. Pp. xxiii + 295. Vol. 2: Subject Index. Pp. xi + 602. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1939.) 50*s*. net.

THE material assembled in these two volumes consists of an index to the bibliography of a subject which is unusually scattered. Spore-forming and non-spore-forming species of anaerobic bacteria have come under review and 10,500 original articles published up to the end of 1937 are cited. In vol. 1 is found a chronological list of all the references arranged alphabetically under the authors' names; complete cross-reference entries are included for each of the joint authors together with the full title of each paper, a task involving approximately 120,000 entries. Vol. 2 consists of a general subject index, the references again being listed chronologically under the author's names; in this volume, however, the title of the paper is not given but can be obtained by reference to vol. 1.

On first inspection the subject index outline appears adequate, but in practice the inherent difficulties of the system are all too quickly apparent. For example, if one desires to know the published work concerning the production of *Cl. welchii* antitoxin, one turns to vol. 2 and finds under the general heading of "Antitoxins" more than 400 entries on the general problem of antitoxin production for any of the anaerobes. Further, the absence from vol. 2 of the titles to papers compels one to refer for each entry to vol. 1; obviously an impracticable task. In the absence of a more clearly defined classification of both spore-forming and non-spore-forming species, it is difficult to see how the authors could have overcome this practical problem. If in future editions of this work vol. 1 was allowed to lapse and remained in the archives as a historian's guide, and the subject-matter of vol. 2 was expanded to include the title of papers the difficulty would, in part, be solved and our searchings simplified. The authors could not have hoped that the system of indexing they have adopted would be generally acceptable by all classes of workers, but they must be gratefully thanked by research workers and historians alike for undertaking the formidable task of collecting and collating such diffuse material.

Everyday Fare for Fitness

By Dr Stanley B. Whitehead. Pp. 166. (London: John Lane, The Bodley Head, Ltd., 1939.) 5*s*. net.

THIS little book, of which the author is an advocate of meatless fare, is divided into two parts. The first deals with what he regards as the merits and demerits of everyday food from the point of view of fitness. Everyday meals which he considers suitable for the manual worker, brain worker and nervous type are described, and tables are included of body-building foods, energy-providing foods, heat-producing foods, and health-protective foods. The second part contains more than two hundred recipes under the headings of breakfast dishes, salads, savouries, roasts and entrées, soups and broths, egg dishes, sweets, puddings and health drinks among which alcohol finds no place.

PHYSICS

Rheology of Suspensions

A Study of Dilatancy and Thixotropy. By Hugo Levin Röder. Pp. xiv + 86. (Amsterdam: H. J. Paris, 1939.)

DILATANCY (the Osborne-Reynolds phenomenon) has proved more difficult to measure quantitatively than has any other rheological anomaly, and the author's failure to obtain satisfactory data for dilatant systems with a modified Stormer viscometer is therefore not surprising.

Röder goes on to describe an apparatus in which a small sphere, rigidly attached to a car drawn on rails by means of a weight, is swept through the material

to be investigated. The friction of this arrangement is considerable, but in the case of a true fluid there is satisfactory proportionality between the applied weight and the rate of shear if a constant friction term is subtracted from the weight. Aqueous pastes of quartz and rice starch give initially a rise in rate of shear as load is increased, but finally settle to a constant rate independent of further loading. In carbon tetrachloride, the same materials show a thixotropic, instead of a dilatant behaviour, and comparison is made with the thixotropic properties of paints. In dilatant systems, the material 'builds up' in front of the shearing body like snow against a snow-plough, a phenomenon similar to that described by Jordan as occurring in the straining of muscles. The thesis ends with a rather inadequate summary of selected books and papers on thixotropy and dilatancy.

Röder's work will be welcomed as making definite progress towards a solution of the important industrial problem of the measurement of dilatancy, but it is to be regretted that the author does not deal more adequately with earlier work, the thesis giving the impression of having been written somewhat hastily. G. W. S. B.

Décharge électrique dans les gaz

Par Prof. Marcel Laporte. (Collection Armand Colin, Section de physique, No 216). Pp. 222. (Paris: Armand Colin, 1939.) 15 francs.

ELECTRIC discharge in gases is the subject of the new volume which Prof. Laporte has added to the useful series of monographs published by Armand Colin. It is remarkable how much information is contained in each of these small and inexpensive books, both the editor of the Physics Section, M. Ch. Fabry, and the author are to be congratulated on this addition to the collection. The first six chapters deal with the ionization of a gas in its various aspects, then come five chapters on various forms of discharge, and the last two are concerned with gas discharge tubes as sources of light, including white light. Honours students of physics would do well to study this book

Theory of Heavy Quanta

Door Frederik Jozef Belinfante. Pp. xii + 126. ('s-Gravenhage: Martinus Nijhoff, 1939.)

SINCE 1937, the evidence from the study of cosmic rays has increasingly pointed to the existence of a particle about a hundred times more massive than the electron, giving support to a suggestion of Yukawa's in 1935 that the forces binding protons and neutrons together in atomic nuclei might be connected with particles of about that mass. Since Yukawa's first paper, much theoretical work has been done and the subject has now reached a stage when a general survey is possible. Unluckily the new particle does not readily lend itself to direct laboratory investigation, and there are still many possible formulations of the theory, all of which have to be elaborated until further indirect comparison with experiment is possible.

It is therefore natural that this tract should deal mainly with mathematical methods and be more useful to the theoretical physicist than to the experimenter. Actually the latter will get even less from it than would have been possible had the material been more suitably presented. The exposition lacks conciseness, and the discussion of the practical conclusions from the theory suggests wide but ill-digested reading. The mathematical style is not elegant; too many symbols are introduced, and equations which could be written more concisely confusingly cover half a page in vector notation at a stage when this is unnecessary. At the present stage of the theory it is of course difficult to choose the best mathematical apparatus; the author advocates the use of "undors", which are expounded in a preliminary chapter.

Psychology

New Ways in Psychoanalysis

By Dr. Karen Horney. Pp. 313. (London: Kegan Paul & Co., Ltd., 1939.) 12s. 6d. net.

THIS book is an attempt to evaluate critically some of the main assumptions underlying the Freudian system. After a somewhat verbose discussion, the author arrives at the conclusion that most of these assumptions have to be discarded and others substituted in their stead.

The argument begins with the assertion that Freud was too much influenced by the mechanistic philosophy of the nineteenth century. His theories of fixation, regression, repetition-compulsion, and of the supreme importance of infantile experience are instanced as types of mechanistic rather than of dialectic thinking. According to Freud, present manifestations of neurotic behaviour are not merely conditioned by the past, they contain nothing but the past. The mechanistic biology of Freud's early days, according to which evolution was merely a redistribution of existing elements, found in his theories a psychological expression. Likewise, his tendency to view psychic processes as pairs of opposites appears to the author as an expression of the dualistic thinking prevalent in the last century, whilst his notion of behaviour as the direct derivative of instinctive patterns is regarded as without basis in fact.

The reader will welcome this critical approach to the subject. He will also welcome the new stress upon sociological and cultural influences in fashioning human behaviour, for he will find this in accord both with current experimental results in the field of conditioning and with the growing realization among social psychologists that the key to motivation is to be sought in the nature of the social environment rather than in innate patterns of conduct. That neurosis arises in particular as a result of the struggle to cope with a hostile competitive environment is perhaps the most interesting point raised in the book. This belief is based on the author's assumption that the dominant human need is for security—principally in the economic sphere.

Laboratory Investigations into Psychic Phenomena
By Hereward Carrington. Pp. 255+25 plates. (London: Rider & Co., n.d.) 15*s*. net.

THIS volume is a useful handbook for those psychical researchers who want to have by them a well-documented and fairly critical account of the attempts that have been made to bring so-called supernormal phenomena into the laboratory and to subject them to tests made by instruments of precision.

After a brief historical introduction the author continues by describing the results of his own experiments, which consisted for the most part of an investigation of the validity of the instrumental tests which had been devised in the past. It is in this section that we meet again with the rather pathetic attempts to demonstrate such alleged phenomena as special human radiations proceeding from hands or eyes; the effect of the will on material objects; or some sort of instrumental communication with the spirit world. In his experiments, designed to repeat the results claimed by earlier enthusiasts, Mr. Carrington met with but little success, and he points out how, in a number of cases, the previous results may have been due to mechanical defects in the apparatus employed, faulty procedure during the experiments, or more simply still to a false interpretation of the readings given by the various devices.

In trying to repeat many of these attempts Mr. Carrington has done a useful work, and the record here printed, even though largely negative (and indeed because of it), will be found to be a wholesome corrective to those who follow in the path of his predecessors, and again attempt to introduce dynamoscopes, magnetometers, sthenometers, volometers and the rest.

Technology

Photography, its Principles and Practice
A Manual of the Theory and Practice of Photography. By C. B. Neblette. Third edition. Pp. xi+590. (London: Chapman & Hall, Ltd., 1939.) 30*s*. net.

ALTHOUGH photography enters very largely into all branches of scientific research, many investigators have only the most rudimentary knowledge of the characteristics of the materials with which they work. No doubt much time and trouble might have been saved had that information been available at the time of experiment. This well-known book—now in its third edition—is just the kind of manual for a scientific worker who is not specially interested in the theory of photography, but who desires a proper scientific account of all the processes of photography in order that he may use the tool to the best possible advantage.

The volume deals with every phase of photography, beginning with the camera and its optical system, emulsions, latent image and sensitometry. The whole of processing to the finished print is given in detail. Even the less usual types of printing process are described in such a manner that they may be practised. Colour photography is dealt with, but in less detail. One very good feature of the book is the system of quoting references. The necessary references immediately relevant to the text are given, but in addition there is on nearly every page a series of references to general articles so that any given topic may be followed up in the photographic literature. 'Neblette' is therefore a useful addition to the library of anyone having to practise photography in a scientific laboratory. It is no less useful to the serious amateur photographer with a limited knowledge of chemistry and physics.

Theory and Design of Valve Oscillators
For Radio and other Frequencies. By Dr. H. A. Thomas. (Monographs on Electrical Engineering, Vol. 7.) Pp. xvii+270. (London: Chapman & Hall, Ltd., 1939.) 18*s*. net.

THE thermionic valve occupies a unique place in the field of communication engineering, in which its use in the generation of oscillations is a particularly important aspect.

The present monograph aims at bringing together all the important work which has been done on valve oscillators of the usual types. Particular attention is given to a detailed theoretical examination of the factors which affect the character of the oscillation. Here, then, one finds, after a preliminary survey of fundamental principles, chapters devoted to efficiency, wave-form and frequency of oscillator systems. In dealing with frequency, the treatment is very full. The frequency changes induced by time changes in the oscillatory circuit itself are given the importance they deserve in a scientific presentation of the subject. Finally, the question of frequency stability is surveyed in all its ramifications.

Dr. Thomas has presented his subject in a clear and ordered way. Due to his expert knowledge, he is able to lay bare the core of a problem with a conciseness that is admirable. This is a book which radio engineers, particularly those on the research side, will find really helpful. L. J.

A Handbook on Ventilation, including Air Conditioning
By Percy L. Marks. Pp. viii+138+1 plate. (London: The Technical Press, Ltd., 1938.) 7*s*. 6*d*. net.

THIS short treatise is not concerned with theories but confines itself to established facts and usage and, in some cases, expresses the views of consulting engineers and manufacturers recognized as experts. The author has adopted a discursive style and, after presenting the general considerations, goes on to describe the several methods employed in various circumstances and the fittings and material used. On the activities of dry rot some valuable information is given, and there is a chapter of ventilation suggestions for different classes of buildings which should prove useful. While the book does not go nearly far enough into detail to constitute an independent guide, it would make a valuable addition to a more formal text-book by reason of the numerous practical ideas it contains.

FORTHCOMING BOOKS OF SCIENCE

Mathematics : Mechanics : Physics

GEORGE ALLEN & UNWIN, LTD. The World and the Atom—C. Moller and E. Rasmussen (translated by G. C. Wheeler) Atoms in Action: the World of Creative Physics—George Russell Harrison. Statistical Methods for Medical and Biological Students—Gunnar Dahlberg.

CAMBRIDGE UNIVERSITY PRESS. Odd Numbers, or Arithmetic Revisited—Herbert McKay. British Association Mathematical Tables, Vol. 8: Number-Divisor Tables—J. W. L. Glaisher; Vol. 9: Table of Powers. Electron Inertia Effects—F. B. Llewellyn. Surface Tension and the Spreading of Liquids—R. S. Burdon. Magnetism and Very Low Temperatures—H. B. G. Casimir.

CHAPMAN & HALL, LTD. Statistical Mechanics—Mayer. Seventh Summer Conference on Spectroscopy—edited by G. R. Harrison. General Physics—R. B. Lindsay. Fundamental Processes of Electric Discharge in Gases—L. B. Loeb. Tables for the Identification of Molecular Spectra—R. W. B. Pearse and A. G. Gaydon. Mathematics of Statistics—John F. Kenney. The Fluorescence and Phosphorescence of Solids—Elemer Forbat. Practical Applications of Spectroscopy—Herbert Dingle.

ENGLISH UNIVERSITIES PRESS, LTD Physical Science in the Service of Art and Industry—E. G. Richardson.

McGRAW-HILL PUBLISHING CO., LTD. Differential and Integral Calculus—R. R Middlemiss. Statistical Procedures and their Mathematical Bases—C. C. Peters and W. R. Van Voorhis. Survey of Mathematics—R. S. Underwood and F. W. Sparks. The Modern Theory of Solids—F. Seitz.

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NEWS AND VIEWS

Sir Benjamin Baker, F.R.S. (1840–1907)

IT is just fifty years ago this month since the famous Forth Bridge was opened and a hundred years ago since one of its designers, Sir Benjamin Baker, was born. The son of Benjamin Baker of Carlow, Ireland, Sir Benjamin was born in Somersetshire on March 31, 1840, and at the age of sixteen was apprenticed at the Neath Abbey Iron Works, South Wales. At the age of twenty he entered the employ of a civil engineer in London and two years later began his long association with Sir John Fowler (1817–98), who was then engaged on the construction of the first part of the London Underground Railway. Baker first gained recognition by a series of articles in *Engineering* in 1867 on "Long-Span Bridges". This series was followed by others on beams, brickwork and urban railways. In the 'seventies plans had been drawn up by Sir Thomas Bouch for a bridge over the Firth of Forth, but the failure of his Tay Bridge led to a reconsideration of the scheme.

In 1881 the railway companies interested requested their consulting engineers T. E. Harrison, W. H. Barlow and Fowler, with whom Baker collaborated, to report on the feasibility of a bridge over the Forth, and the type of bridge. The report recommended a cantilever bridge with a central supported girder, a type first adequately treated by Baker in his articles of 1867. The great work was begun in 1883 and completed in 1890, Baker then receiving the honour of knighthood. The second great work for which Baker will be remembered is the Aswan Dam on the River Nile, 6,400 ft. in length, carried out in the years 1898–1902 at a cost of £3,250,000. He was consulted regarding many projects both at home and abroad, acted as an arbitrator, and served on many commissions and committees. He was elected fellow of the Royal Society in 1890, and served as president of the Institution of Civil Engineers in 1895. He died unmarried on May 19, 1907, and was buried at the village of Idbury in the Cotswolds. Two years later a memorial window to him was erected in the north aisle of Westminster Abbey.

Substitutes for Imported Fuels

IN the House of Commons, on March 20, Mr. Geoffrey Lloyd, Secretary for Mines, stated that Sir Harold Hartley had been appointed honorary adviser on the development of home-produced fuels. A number of leading representatives of industry, finance, and technical science, under the chairmanship of Sir William Bragg, had been asked to make a rapid survey of the subject in the light of war conditions, and within a month this authoritative body completed its survey. On its recommendations the following six specific problems are being investigated simultaneously: (1) the production of oil from coal by synthetic processes, under the chairmanship of Sir William Jowitt; (2) the products of low-temperature carbonization, under Lord Henley; (3) the liquid products of high-temperature carbonization, under Mr. Davidson Pratt; (4) alternative fuels for internal combustion engines, under Viscount Ridley; (5) the development of the use of colloidal fuel, under Mr. Irvine Geddes; and (6) the more efficient use of fuel generally, under Sir Clement Hindley.

A report has already been received, Mr Lloyd said, on the recovery of benzole. This indicates that already additional crude benzole is being recovered at the estimated rate of 15,000,000 gallons a year, and that an extension of voluntary effort should secure a further 12,000,000 gallons a year. A survey has also been completed which shows how our production of tar, creosote, and pitch can take the place of imported fuel oil and bitumen to the extent of some 300,000 tons in the current year. Mr Lloyd stated in conclusion that action already taken on the basis of reports received will result in obtaining in the current year some 32,000,000 gallons of substitutes for imported oil.

Economic Aspects of War

THE economic aspects of war are ably discussed by Mr. G. Crowther in an Oxford Pamphlet on World Affairs (Oxford: Clarendon Press. 3*d*. net), entitled "The Sinews of War", in which he maintains that war is now an industrial proposition, being more influenced by the science of economics than by the art of strategy. The demand of war for the whole of a nation's industry and wealth has given an immense advantage to the rich country. Limiting himself to the question of men and materials, Mr. Crowther compares the resources of man-power and materials available to the Allies and to Germany. In almost every respect the Allies have an overwhelming advantage, and our advantage in man-power will increase the more Germany succeeds in making her raw materials at home. To win the War, however, even with these advantages, economic mobilization is essential. We must keep the seas open to our trade while closing them to the enemy; we must prevent the enemy from over-running our industrial areas or bombing them out of existence before they convert our advantages of man-power and materials into a military superiority. We must also preserve our ability to pay for imports by maintaining and increasing our export trades, and be prepared to reduce to the minimum the amount of man-power and materials consumed for purposes other than war. Finally, we must be energetic and speedy in organizing the transfer both of men and materials into their war-time jobs. In laying down programmes of war production, we must be content with nothing short of the maximum that is physically possible.

Tuberculosis and War

IN a recent paper on this subject (*Paris méd.*, 1, 52; 1940), Dr. E. Rist, of Paris, remarks that war favours the extension and aggravation of tuberculosis not only in belligerent nations but also in neutral countries, owing to the economic disturbance caused by the blockade, the scarcity of indispensable articles due to the destruction of merchant shipping and the hindrances of all kinds offered to the transport of goods by land and sea. During the War of 1914–18, the mortality curve from tuberculosis, which had fallen from 1900 to 1914, rose sharply from 1915 to 1918, and did not decline again until after the conclusion of peace. Among the numerous causes of an increase of endemic tuberculosis in war-time, one of the most serious is the rapid and wholesale evacuation of urban and rural populations to districts which are not sufficiently prepared to receive them, with the result that numerous healthy persons become infected with tuberculosis by those suffering from an active form of the disease.

Another factor leading to increase is the interruption of the most successful method of treatment of pulmonary tuberculosis, consisting in various forms of collapse therapy, especially artificial pneumothorax, caused by evacuation of patients to areas where there are no practitioners familiar with the technique. Other factors found to be responsible for the spread of tuberculosis are overwork, especially among those engaged in war industries of various kinds, under-feeding, as was illustrated in Denmark during 1914–18, and mental worry, the importance of which was emphasized by Laennec long ago. In conclusion, Dr. Rist, while admitting the necessity of an ample supply of tuberculosis experts in the armed forces, emphasizes the importance of restoring to civil practice a large number of them who are employed on quite unsuitable duties.

British Museum (Natural History)

LECTURE tours in the British Museum (Natural History) on Saturdays at 3 p.m., and on the first Sunday in each month at 3 p.m. have been arranged. London museums are re-opening their doors, and although many treasures have had to be moved away to safety from the Natural History Museum, their places have been filled to some extent by special exhibitions and new grouping. Two of the galleries are being used for a special exhibition to show Nature in the service of man. The exhibits illustrate the animals and plants from which our most important textiles are produced; sources of oil, animal, vegetable, and mineral, and some of the industries in which the various oils are needed; materials from which cosmetics and surgical requisites are prepared; the use made of spiders' webs and the origin of domestic breeds of poultry, cattle, pigs, etc. There is a section showing the animals particularly useful in war, such as white mice, canaries, reindeer, and Airedale dogs. Another gallery which has been proving a great attraction during the few weeks of limited opening is the Whale Hall, where a full-size model of a Blue Whale 92 feet long is on view—a treasure certainly, but much too large for evacuation!

Night-Shining Eyes

MOST people are familiar with the greenish gleam which shines from the eyes of a cat when a beam of light is directed upon them at night, and are aware that the glow can be seen only when the observer's line of vision is closely parallel with the beam of light. The phenomenon has been investigated in many animals by E. P. Walker, assistant director of the National Zoological Park of the Smithsonian Institution, and his results are referred to in the current Year Book of the Institution. The apparatus used in the tests was a reflecting head lamp, similar to a hand torch, worn on the forehead and connected with a three-cell battery in his pocket. The best results were obtained with a beam of moderate intensity, the effect of an intense beam being to make the glow less conspicuous or entirely to prevent its appearance. The shining is due to reflection from some surface in the eye, but its colour and character vary with the kind of animal. Colour ranges ran from silvery to blue-green, pale gold, reddish-gold, brown, amber and pink, and while most resembled reflection from a burnished metal surface, those of crocodiles and alligators gave the observer the impression of gazing into "a brilliantly glowing pinkish opening in a dull-surfaced bed of coal".

In the case of glowing eyes, the appearance is as if one looked through the pupil of the eye and saw reflection from the surface of the retina, but where the gleam was metallic in character there was no impression of looking into the interior of the eye. In the latter case, however, a difficulty arose because in most cases the reflection disappeared at a distance closer than from eight to twenty feet, so that the actual reflecting surface could not be determined. In some forty species of mammals and reptiles tests were made with red and blue coloured beams of light, but these made little change in the reflected gleam except to add a corresponding tinge of red or blue, a result which confirms the suggestion of simple reflection without any real animal light. To some degree there is a family resemblance in the character of the gleams, for most rodent eyes shine dully in brown, hazel or amber, although in porcupines the reflection is brilliantly silver. No shine was obtained from the eyes of higher apes or monkeys and no proof of the alleged shining of human eyes, yet, curiously enough, the most brilliant reflections of all were from the eyes of two of the lemurs, the slow loris and the potto.

Ethnological Reconnaissance in New Guinea

MUCH of the Mandated Territory of New Guinea is still uncontrolled, and even unexplored. Notwithstanding the difficulties of the country, the policy of exploration with a view to control is pursued with as little intermission as circumstances allow and has made substantial additions to knowledge in the information collected relating to the culture of previously unvisited or unknown peoples of the interior, notably in the regions adjacent to Mt.

Hagen. A recent report to Sir Walter McNicoll, administrator of the Mandated Territory, by Mr. J. L. Taylor, assistant district officer, records the results of a patrol carried out by him in unexplored country westward from Mt. Hagen to the border of Dutch New Guinea, and northward towards the southern tributaries of the Sepik River during March 9, 1938–June 19, 1939. The area surveyed consisted of some 20,000 square miles, and was found to be for the most part of temperate climate, such as might be suitable for European occupation. The future of the country traversed is said to lie in agriculture and pig-raising.

Large numbers of natives were encountered, most of whom appear to have been friendly, though on more than one occasion the patrol was attacked and suffered some casualties. Among natives to the north-west of Mt. Hagen, who had not previously seen a white man, the members of the patrol were regarded as spirits of the dead returned to earth. One of them, while taking observations from a tree, received the offering of a pig and was asked to ascend to heaven. In another village, the women were kept at a distance in the belief that they would die if they beheld these spirits. Among the more remarkable features in the culture of the peoples encountered, of which some particulars are given in a dispatch from the Canberra correspondent of *The Times* in the issue of March 26, is a system of deep drains or sunken roads, in the form of an elaborate complex of trenches, which serves both for defence and in cultivation as an effective drainage system, or as a protection against the ravages of pigs. Another remarkable culture trait is the use of wigs of human hair, made by professional wig-makers. Each man, it is said, aimed at having at least one wig made of his own hair. The tribes of the area were found to be keen traders, the most important and much sought after commodity being salt prepared from wood burnt after saturation in salt-springs.

Archæological Investigations in Jerusalem

EXCAVATION of the remains of certain of the ancient walls of Jerusalem carried out by Mr. C. N. Johns on behalf of the Department of Antiquities has produced results of considerable archæological interest and historical importance. These results include the establishment of a chronological sequence in the remains of these ancient walls, which carries back to pre-Herodian times—certainly to the Maccabees and possibly even to the days of Nehemiah, although the evidence for the latter is archæologically undated. A further result is the confirmation of a tentative identification, made in the seventies of the last century, of the so-called Tower of David with Phasael, the third of the three towers described by Josephus as erected by Herod the Great. The systematic exploration of the site was made possible by the demolition of the Turkish barracks under the British occupation, and was undertaken by the Department of Antiquities in 1934 through the direct personal interest of Sir Arthur Wauchope, then High Commissioner.

The excavation, as described in a dispatch from the Jerusalem correspondent of *The Times* in the issue of March 23, has laid bare the old wall inside and parallel to the present north and west walls of the Citadel as reconstructed by the Crusaders and Mamelukes. This fragment of the old wall consists of three towers, Phasael and those named respectively by the excavators the Corner Tower and the South Tower, and their connecting curtain walls. The curtain between Phasael and the Corner Tower is of crude chalky stone solidly laid without mortar on the native rock scarp. Stratified remains of pottery suggest that this *may* go back to Jonathan Maccabæus; but in fact it incorporates an even earlier and clumsier wall, as previously mentioned, archæologically undated. The Maccabæan wall was partially demolished shortly after its erection, in a battle, presumably during the sieges by one or other of the Antiochus dynasty, of which the relics are seen in iron and bronze javelin heads and stone ballista balls. There is now evidence that after repairs it was reconstructed in the remarkable protective works of Herod, in which the tower Phasael was the strongest and most striking, rising from a cube of solid masonry, measuring 68 ft. on each side, in two stages to a height of 155 ft. In addition to their intrinsic interest, these discoveries will tend to throw light on other problems of the character and appearance of the Holy City at the opening of our era.

Trotula and the Ladies of Salerno

IN a paper read before the Section of the History of Medicine of the Royal Society of Medicine on January 10, Dr. H P. Bayon stated that several contemporary writers maintained that a fictitious Trottus was the author of "De passionibus mulierum", which was usually ascribed to Trotula of Salerno, a matron mentioned in the text of most manuscript copies and therefore a definite person. Whether she wrote or compiled the chapters "De ornatu mulierum" is not ascertained, but a study of early manuscript texts dealing with cosmetics seems to afford some clue. The gynæcological chapters are notable because of the recommendation of the support of the perinæum in childbirth and the primary suture of the perinæum. The many manuscript copies, printings and literary allusions concur in showing the appreciation which Trotula enjoyed during the twelfth to sixteenth centuries.

The references in the text of Trotula's work to Saracens, many drugs from the East, the avoidance of magical formulæ and hagiology, together with the description of alchemical manipulations, indicate the personal influence of Moslem and Hebrew physicians; in other Salernitan writings, quotations from the Old Testament are preferred. It is recorded that Costanza of Salerno lectured on medicine during the reign of Giovanna I of Anjou (1326–82); she was probably the first woman professor. The decline of the College of Salerno must have occurred after its destruction in the sack of the town in 1194. In academical teaching Salernitan doctrines were replaced by dialectic scholastic medicine, but the

College of Salerno brought to the West a system of professional medical practice which has since prevailed in all parts of the civilized world.

A New Kind of Museum Exhibit

THE New England Museum of Natural History in Boston, Mass., has been the first to turn a trade innovation in lighting to the service of museum galleries. In the particular case described by Bradford Washburn in the *Museums Journal* (39, 450; 1940) you gaze at a stoat watching you from the edge of a summer wood. As you look, the lights fade, become momentarily dim, and when the full light shows again the summer scene has gone, snow covers the ground, the trees are bare of leaves, and the stoats have changed into their winter dress of ermine. The case really contains two groups, a summer and a winter one; but the spectator looking at the summer group perceives it, when it is brilliantly lit internally, through a transparent sheet of Belgian 'black' glass. When the internal lights fade and the second group is illuminated, the black glass becomes opaque and acts as a mirror in which only the snow scene is visible, exactly overlapping the summer scene, of which it is a replica in reverse Many technical difficulties had to be surmounted before the new exhibit was satisfactorily completed; but its dissolving habitat group at once made a great impression. One wonders if the average mortal really needs such bait in order to be induced to look at a representation of Nature: and the result -half his mind is thinking about the trick of the thing; only the other half is giving itself to the study of the Nature group.

Earthquakes Near Great Dams

ACCORDING to *Earthquake Notes* (11, No. 3; January 1940), earthquakes of varying intensity have been recorded from the neighbourhood of Boulder Dam since September 1936. During the first four months twelve shocks were felt, but the frequency increased until during April 1937 forty-five were felt After this time the frequency increased until during the early part of 1939 there were on average two humanly felt earthquakes a month. The Wood-Anderson seismograph on the spot recorded more than five hundred disturbances during 1938. There has been some discussion among U.S. seismologists of plans for the observation of possible earthquakes in the neighbourhood of two other areas which will probably be similarly loaded. The first is the unfinished Grand Coulee Dam in the State of Washington, and the second is the proposed Shasta Dam near the confluence of the Pit and Sacramento Rivers in northern California. In the latter case there is yet time to obtain information of the seismicity of the area before loading. Similar data were not obtained in the case of the Boulder Dam.

Oxygen Administration and Inhalation Apparatus

A FIFTH memorandum in the Emergency Medical Services Series has been issued by the Ministry of Health entitled "Oxygen Administration—Indications, Methods and Types of Apparatus" (H.M. Stationery Office. 2*d*. net). The administration of oxygen is a valuable aid in the treatment of some forms of gas poisoning and lung disease, and in some surgical conditions such as shock and chest wounds. The memorandum incorporates the results of research on the subject, and is intended primarily for the guidance of medical officers in charge of hospitals. It describes the conditions for which oxygen therapy is likely to be effective, methods of oxygen administration, and the more important types of apparatus for the purpose, including a new form of nasal mask.

Alexander Pedler Lecture

THE Alexander Pedler Lecture, which is given annually under the auspices of the British Association, was this year delivered by Prof. Allan Ferguson before the Cardiff Naturalists' Society. The lecture, which was given in the Reardon Smith Lecture Theatre of the National Museum of Wales, Cardiff, on March 14, was entitled "Splashes, and what they Teach". It was chiefly concerned with an explanation of the phenomena attendant on the impact of a drop of liquid on a liquid or solid surface. A high-speed film was shown which illustrated the phenomena, and the results were compared with those of the earlier classical experiments carried out by the late Prof. Worthington

Old Books on Social Sciences

WE have received a copy of Catalogue 54 published by E. P. Goldschmidt and Co., of 45 Old Bond Street, W.1, containing 307 items of old works dealing with a great variety of subjects. Attention may be directed to the following: Jacques Legrand's "Sophologium", a popular handbook of useful knowledge, possibly printed by Caxton, not later than 1473; Naudé's work on the principles of librarianship and library organization (1627); Beccaria's treatise on crimes and penalties (1766); Sir Edwin Chadwick's "Report on the Sanitary Condition of the Labouring Population of Great Britain" (1842); Patissier's work on factory hygiene and the diseases to which miners, industrial workers and others are exposed (1822); Schreiber's sixteenth century book on practical arithmetic, the first German book on the subject; Jérome de Monteux's treatise on hygiene, which contains chapters on dietetics, the care and nourishment of children, and a section on cosmetics (1559); Bernard Palissy's discourse on the nature of waters, fountains, rains, metals, salts, stones, earths and fire (1580), which entitles him to be regarded as one of the pioneers of modern chemistry and geology; Neander's "Tabacologia" (1626), the most important early work on tobacco; Villafranca's "Methodus refrigerandi" (1550), the earliest work on artificial refrigeration; and the first edition of Linnæus's book on the increase of the habitable earth (1744) bound up with the second edition of his oration on travelling in one's own country (1743).

Hydro-Electric Development in India

IN NATURE of January 6, p. 23, under this heading, it was stated that an irrigation scheme involving the generation of large quantities of electric power between the Punjab and the State of Bilaspur "is under construction". We are informed by the secretary of the Central Board of Irrigation that "the project referred to, namely the Bhakra Dam Project in the Punjab, is not 'under construction' but simply 'under consideration' at present".

Exhibition of Chinese Art at Leeds

AN exhibition of Chinese art was opened in the Temple Newsham Mansion, Leeds, on March 23 by Dr. Thomas Bodkin, Barber professor of Fine Arts and director of the Barber Institute in the University of Birmingham. The exhibition consists of more than 200 specimens of pottery, paintings and bronzes, exhibited by the courtesy of Messrs. John Sparks of London, and on the initiative of the curator of Temple Newsham, Mr. Philip Hendy. Although the exhibition is, so far as possible, comprehensive in a chronological sense, the periods which will appeal most to students of the earlier phases of Chinese culture, covering the Shang-Yin (? 1766–1122 B.C.) and Chou (? 1122–249 B.C.) Dynasties and the Warring States, are represented by some notable exhibits forming a group of seven very rare bronzes. Three belong to the Shan-Yin Dynasty—two beaker-shaped vessels with a finely engraved design, and a sacrificial cup. There are also three vessels of the Chou Dynasty; and a dagger with a handle in the form of a mule's head is of the period of the Warring States (481–221 B.C.). Special interest is attached to these bronzes, all coming from burials. Among the most important of the pottery exhibits is the figure of a Lohan or Buddhist priest, seated with arms folded in the sleeves of his cloak, which stands about four feet high.

A Big Sunspot

A BIG sunspot has crossed the solar disk during the past week; appearing at the east limb on March 20, reaching the central meridian on March 26·3 and due to pass around the west limb of the disk on April 1. The area of the spot on March 23 was 1,000 millionths of the sun's hemisphere—an area well above the lower limit of size for naked-eye visibility. On March 23, a bright chromospheric eruption of considerable intensity was observed directly over the spot. A great magnetic storm began on March 23 and was in progress during the night of March 24–25, when the aurora was also seen in spite of bright moonlight. Widespread interference with both radio and cable communications was reported.

The Night Sky in April

DURING the month, night shortens by nearly two hours in the latitude of London. The moon is new on April 7 at 20·3h. and full on April 22 at 4·6h. On the latter date, a penumbral eclipse of the moon occurs, having been preceded on April 7 by an annular eclipse of the sun invisible in Great Britain, but to be seen in the southern parts of the United States of America. The penumbral lunar eclipse on April 22 begins at 2h. 27m., reaches a maximum phase (0·89) at 4h. 26m., and ends at 6h. 25m. In the nature of things, a penumbral lunar eclipse is not a spectacular phenomenon, but a difference in brightness between the east and west parts of the moon's disk should be discernible in a naked-eye scrutiny. In the evening skies after sunset, the brilliant planet Venus dominates the other planets still above the horizon—Mars, which is visible for about three hours after sunset, and Saturn, drawing nearer to the sun's position until it is in conjunction on April 24. Jupiter is now too close to the sun for observation, being in conjunction on April 11. It may be noted that also on April 11 at 0h. Venus is in conjunction with Mars; while at 19h. the moon, then nearly four days old, will be in conjunction with both these planets. The Lyrid meteors are due during April 19–22, the radiant point being near 104 Herculis. [All times are given in Universal Time; add 1 hour to convert to Summer Time.]

Announcements

SIR HAROLD CARPENTER, F.R.S., professor of metallurgy in the Royal School of Mines, London, has been awarded the Honda prize of the Japan Metallurgy Society. He is the first foreigner to receive the award, which consists of a gold cup and £300.

PROF. A. V. HILL, M.P., F.R.S., has been appointed as assistant air attaché in Washington for special scientific liaison duties. The appointment is temporary, and has been accepted without remuneration.

THE Messel Medal of the Society of Chemical Industry has been awarded to Lord Samuel. This medal, one of the two principal awards in the hands of the Society, is given in alternate years for "meritorious distinction in Science, Literature, Industry or Public Affairs, and who is prominently concerned with the Welfare of the Society". The presentation will be made at the annual meeting of the Society to be held in London on July 9, when Lord Samuel will deliver an address.

THE Kitasato Institute for Infectious Diseases, founded at Tokyo, by Baron Kitasato, who discovered the bacillus of bubonic plague and who died in 1931, celebrated the twenty-fifth anniversary of its foundation on November 5.

ACCORDING to Dr. C. Louis Leipoldt, medical secretary of the Medical Association of South Africa, in Southern Rhodesia where there are 188 registered medical practitioners, 115 are available for service in the present national emergency.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 516. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Human Genera and Species

PROF. OSMAN HILL'S suggestion[1] that the classification of the Hominidæ is in urgent need of revision is likely to meet with general agreement. It is doubtful, however, if the particular proposals which he puts forward will do more than deliver the question from its present confusion—a confusion which at least has the merit of attributing a glamorous if unreal diversity to human ancestry—into another confusion at least as great. This is certain to occur if the principles of zoological classification are as he defines them. The differences which he suggests indicate generic distinctions ("differences in external or internal structure") cannot be regarded as essentially different from those which he believes to indicate specific distinctions ("differences in bodily proportions . . . differences in bodily form", etc.). For, quite apart from the verbal and logistic difficulty of deciding what is a difference in "structure" and what is a difference in "form", there is strong reason for supposing that pronounced differences in the one or the other or both aspects of the body or its organs are often simply due to differences in growth-rates. For example, some monkeys have a vermiform appendix, others lack this structure. Osman Hill's criteria suggest that differences of this kind are necessarily a sign of generic distinction. The difference, however, is entirely dependent on a different pattern and rate of growth in the cæcal region of the large intestine, that is, on a process which in this case leads to an extreme difference in bodily proportions. These, however, Osman Hill regards as indicative of specific and not generic distinction. It would therefore seem that no real difference separates his criteria for defining genera and species. In any event it is difficult to see how they could be applied to fragments of fossil human skulls.

It is because systematists have never succeeded in devising any standards of general application that zoological classification remains the somewhat uneven structure that it is. In spite of all attempts at suppression, the personal factor still enters largely into decisions that this or that group of animals constitutes a species of a genus. Some systematists are 'lumpers', others 'splitters', and however much it may be regretted as indicative of a lack of objectivity, Tate Regan's remark[2] that a species is something which a competent systematist recognizes as such still holds. But this does not mean that arbitrary conventions are not devised and used which allow of fairly equal generic and fairly equal specific subdivision within a given group of organisms. It was in the belief that this was so that I suggested in 1931[3] that there was no reason to regard Java man (Pithecanthropus) and Pekin man (Sinanthropus) as generically distinct. This view was reaffirmed last year by Le Gros Clark[4] and has just been re-stated by von Koenigswald[5] and Weidenreich.

Any rigid set of principles of systematic classification based, as Osman Hill's are, on a supposed application of principles derived from other fields of biology, usually defeats itself. One has to be particularly careful about such principles in the study of human origins because, as I have suggested elsewhere[6], the importance attached to this question, and the consequent and inevitable derivation of views on primate phylogeny from primate classification, make it essential that the genera within a single family, or the species within a single genus, should be at least approximately equivalent in their taxonomic differentiation, if the theoretical condition is to be fulfilled that the sub-groups of a given genus or family can be regarded as more closely related to each other by descent than they are to the members of other genera and families. This necessity applies to the whole field of palæontology. In a recent review of the problem, Arkell and Moy-Thomas[7] point out that every new genus and species of fossil should fit as nearly as possible into a uniform scale of classificatory values, and that classification should not be complicated by the introduction of preconceived, and usually arbitrary, views about phylogeny.

In the classification of the Hominidæ it is clear (*a*) that a difference which in one case serves as part of the basis for generic differentiation should be given equal consideration in another, and (*b*) that any common characters which bind the species of Homo into a single genus should not occur in any other genus of the Hominidæ. These are purely empirical and, to that extent, arbitrary criteria. But they are essential criteria if there is to be any order in the classification of the Hominidæ, and if views on human phylogeny are to be soundly based. The main difficulty that usually lies in the way of their application to the classification of any new human fossil skull is the desire to make too much of a good thing by magnifying its significance. This was certainly done, either consciously or unconsciously, in the case of the Pekin skull, and the only new fact which Weidenreich's recent announcement implies is that he has at last looked objectively at all the evidence which should have been taken into account at the start of his labours—for in my opinion[8] his conclusion was obvious from the moment Davidson Black published the measurements of the first two Sinanthropus skulls in 1930 and 1931[9], even though he, too, insisted on the distinctive generic separateness of the type. But in this, Black's successor in the excavations of Choukoutien has behaved no differently from almost every other discoverer of a fossil human skull, for the tendency to make too much of such a discovery appears to be irresistible.

An excellent example is provided by the recently described Swanscombe skull, which an impartial committee of experts set up by the Royal Anthropological Institute agreed, after exhaustive examination, differed in no significant way from modern human skulls[9]. In what amounts to a minority report, however, Marston[10], its discoverer, dissociates himself from this view and claims that the skull is much more primitive than this, even more primitive than the Neanderthal group!

If these controversies are to be avoided, it must be accepted by physical anthropologists that the species concept as used in systematics is artificial (however much meaning the term 'species' may have in another context, for example, ecological, as signifying a genuine biological unit), and that in consequence it is necessary to define the amount and kind of differentiation which, in the family Hominidæ, should determine either specific or generic status. At the present time there does not seem to be any more reason than there was ten years ago[3] for separating generically from one another in classification such archaic types as Sinanthropus, Pithecanthropus, Neanderthal and Rhodesian man. The only classification which still appears to be justified to-day is the separation of this group from a group comprising modern man, types belonging to the Upper Palæolithic, and such temporally aberrant types as the Swanscombe skull. The facts demand such a classification—whatever be its phylogenetic significance.

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March 2.

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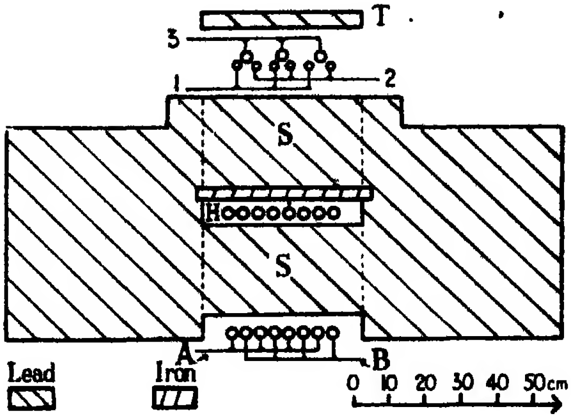
Penetrating Cosmic Ray Showers

It is now recognized that the majority of cosmic ray showers at sea-level consist of electron cascades (see, for example, Jánossy[1] and Lovell[2]). The present investigation gives evidence for the existence of a very small number of penetrating showers remaining after the cascades have been removed by suitable absorbers. The frequency of these penetrating showers, however, amounts only to a few per cent of all showers at sea-level. They therefore could not be detected in the experiments referred to above, or in the similar experiments of Schmeiser and Bothe[3].

The experimental arrangement is shown in the accompanying diagram. The counters shown joined with lines are connected in parallel, giving five-fold coincidences 1-2-3-A-B. Each five-fold coincidence registered corresponds to a shower containing more than one particle near the top counters as well as near the bottom counters. The eight counters H are placed in the middle of the absorber S in order to obtain evidence on the number of rays in the shower. These counters control small neon indicators in such



a way that whenever a five-fold coincidence 1-2-3-A-B occurs, the lamps indicate the number n of the counters H which are discharged simultaneously with the coincidence. The neon flashes were recorded photographically. Some of the experimental results are collected in the table below.

Absorbers (cm Pb)		Records containing n flashes (rate per 100 hour)		
T	S	n = 0 or 1	$n \geqq 2$	n = 0 – 8
0	50	11 ± 2·5	8 ± 2	19 ± 3
Various thicknesses 1·8 – 10·0 cm	50	32·5 ± 2·2	15·6 ± 1·6	48 ± 3

Since the bottom counters are effectively surrounded by 50 cm. of lead, each shower giving rise to a coincidence necessarily contained particles penetrating at least 50 cm. of lead whatever the direction of the shower particles.

It can be calculated that a cascade shower which penetrates 50 cm. of lead must have an initial energy of at least 10^{10} ev. If electrons or photons of this energy were sufficiently frequent to account for our observations, they would have to transfer an enormous amount of energy into ionization on their way through a lead absorber. This ionization can be shown to be larger than the total ionization produced by the whole cosmic ray beam, and would therefore be incompatible with the known rate of ionization. If, therefore, the Bethe-Heitler theory is valid for very high energies, the showers cannot be cascades.

A meson may produce two independent secondaries, one near the top and another near the bottom counters, and so give rise to a five-fold coincidence. In general, such a 'double knock-on' will give rise to a record n = 0 or 1, according as to whether the primary meson is, or is not, recorded by one of the counters H. In fact, the observed number of records n = 0 or 1 is in good agreement with the estimated rate of double knock-on processes. Only a small fraction of the double knock-on showers should produce independent secondaries near the counters H and so give rise to records with $n \geqq 2$. The observed rate of records $n \geqq 2$ is, however, more than 50 per cent of those with n = 0 or 1. We conclude, therefore, that the records with $n \geqq 2$ are *not* due to multiple knock-on showers. This conclusion would be invalidated if the cross-section for head-on collisions of mesons with electrons for energies above 5×10^{10} ev. should prove to be essentially larger than that calculated by Bhabha[4] or Massey and Corben[5].

Assuming, however, that the theories are correct, the records $n \geq 2$ must be interpreted as due to penetrating showers different from cascades and knock-on showers.

We have carried out experiments which suggest that these penetrating showers are connected with the extensive air showers. This is in agreement with the conclusions of Auger[6] and with recent experiments of Wataghin[7].

Though other interpretations cannot be excluded, it is plausible to assume that the observed showers contain several mesons simultaneously. The photographs of Braddick and Hensby[7] appear to show examples of two associated mesons.

Comparison of the coincidence rates for $T = 0$ and $T \gtrsim 1 \cdot 8$ cm shows that less than half the penetrating showers come from the air, while the rest are produced in the absorber T. It seems possible, therefore, that some of the observed showers are due to creation of mesons in the absorber T.

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Origin of Visual After-Images

IT is sometimes disputed whether visual after-images are due to retinal or central processes. Their retinal origin appears to be capable of demonstration as follows. If one eye is pressed with the finger or a spring balance near the outer canthus for about thirty seconds, it will become temporarily blind. This effect, known to Thomas Young, Helmholtz and Donders, is attributed to retinal anoxæmia. The pressure should be about 250 gm., applied over an area of 1 sq. cm. The easiest method is to press on top of the lids, keeping them sufficiently far apart to permit vision. A brown mist will spread over the visual field, and finally all objects will disappear. The image of a bright light, such as a 60-watt bulb, at a distance of 1 m. or 2 m. should now be thrown on a fixed region of the retina in the blind eye.

The easiest method is to fixate the light with the other eye; the natural convergence of the two eyes will cause the other to remain stationary though the pressure will prevent the image from falling exactly on the fovea. Such fixation is maintained for two minutes; the normal eye may be closed for a second from time to time, to make sure that the other eye is still completely blind. If, finally, the head is turned away from the light and pressure removed an after-image of the light will, of course, be seen with the normal eye on any suitable surface, being dark on a bright background and bright on a dark one.

If the normal eye be closed and the other opened ten seconds or so after pressure has been released, its vision will be found restored, and *an after-image positive or negative, will be seen against a suitable background, though the stimulation from the primary image has never reached the lower and higher visual centres at all.*

The image will usually be eccentrically placed in the visual field, through lack of normal fixation, and may be blurred or multiple owing to eye-movements. It may also be feebler at first owing to incomplete recovery of vision in the pressed eye. Under suitable conditions, however, its similarity to the image in the other eye leaves no doubt that both originate in the same way. This confirms the view that the positive after-image seen on a dark ground is due to retinal after-discharge, and the negative image on a bright ground to local reduction of retinal sensitivity. Since these effects occur despite anoxæmia, their photochemical origin is confirmed. The same result is obtained if the unpressed eye has been closed throughout, but fixation of the blind eye is then very difficult and there is no normal image for comparison. It is not denied that central processes may exert an inhibitory influence on these after-images.

Induced anoxæmia of the retina thus provides a useful method of blocking impulses between the retina and the visual centres and of isolating the contributions of different parts of the system to the sensory process.

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Metabolism of Tumours

IN a recent review[1] of the 1939 report of the British Empire Cancer Campaign, Dr. E. Boyland criticizes as "rather misleading" the following statement from the report of this Laboratory: "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. Firstly the ability of cancer cells to form lactic acid persists even when the tissue is respiring, secondly cancer tissue has a respiratory quotient indicating that the oxidation of carbohydrate is abnormal".

This statement, far from being misleading, seems to me to be clear and correct: tumour tissue differs from most normal tissues in these two respects. In an earlier report[2] we had stated our view at length: following our findings[3] that kidney medulla has a powerful aerobic glycolysis not only in Ringer solution but also, contrary to György *et al.*[4], in serum, we said[3]: "In these somewhat rare cases, therefore, aerobic fermentation is certainly not associated with growth, still less with malignancy. Aerobic glycolysis is not specific for tumours, though practically all tumours have strong aerobic glycolysis". Later we studied cartilage[5] which we found[6] to have a similar type of metabolism. These are clearer examples than retina, since these tissues are probably no more damaged than in other tissue-slice experiments. Bone marrow glycolyses aerobically in Ringer's solution[7], though the preparation used by Fujita[8] had low aerobic glycolysis in serum.

Some of Dr. Boyland's other examples are less satisfactory. Liver[9,10], smooth muscle[10], diaphragm[11] and normal lymph glands[12,13,10] have all been reported with insignificant aerobic glycolysis compared with that of tumours. In fact, the transformation of normal liver into a hepatoma is a striking example[14,15]

of the development from normal liver metabolism of "The type of metabolic activity characteristic of malignant tissue generally, that is, active glycolysis with a relatively high value for the aerobic glycolysis"[15]. This important result does not seem to favour the view that cancer tissue arises in general from normal tissue with a cancer-like metabolism.

Normal skin glycolyses aerobically and undergoes relatively little alteration of metabolism when it becomes papillomatous[16], but when muscle is replaced by malignant sarcoma a great increase of glycolysis occurs[16]. In observations of which details are not yet published, Berenblum, Chain and Heatley[17] found with isolated epithelium of skin and of Shope papilloma little difference of metabolism or of *R.Q.*, the latter being low in both. Thus their results on skin epithelium appear to resemble those of Bywaters[5] on synovial membrane. If we exclude retina, of which the *R.Q.* is controversial, these two examples represent the present exceptions among normal tissues to both our generalizations. Although both are tissues of low metabolic activity, it is likely that similar characteristics will be found in more active tissues as the search proceeds. It is clear that neither of our generalizations, nor both in combination, is in the strictest sense specific for tumours. Nevertheless, the association in tumour metabolism of relatively high aerobic and anaerobic glycolysis with the lowered *R.Q.* is such a constant one that to dismiss it is to discard as unimportant the most characteristic of established biochemical peculiarities of tumour tissue.

F. DICKENS.

Cancer Research Laboratory,
North of England Council of the
British Empire Cancer Campaign,
Newcastle-upon-Tyne.
Feb. 23.

[1] NATURE, 145, 246 (1940).
[2] *Ann. Rep. Brit. Emp. Cancer Campaign*, 13, 158 (1936).
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[4] György, P., Keller, W., and Brehme, T., *Biochem. Z.*, 200, 356 (1928).
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[7] Orr, J. W., and Stickland, L. H., *Biochem. J.*, 32, 567 (1938).
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[10] Rosenthal, O., and Lasnitzki, A., *Biochem. Z.*, 196, 340 (1928).
[11] Meyerhof, O., Chemische Vorgänge im Muskel, Berlin, 1930, p. 55 and own unpub. results (in serum).
[12] Victor, J., and Winterstein, M. R., *Amer. J. Cancer*, 22, 561 (1934).
[13] Victor, J., and Potter, J. S., *Amer. J. Cancer*, 33, 554 (1938) (p. 558, correction).
[14] Nakatani, M., *et al.*, *Gann*, 32, 240 (1938).
[15] Orr, J. W., and Stickland, L. H., *Ann. Rep. Brit. Emp. Cancer Campaign*, 16, 161 (1938), and *Chem. and Ind.*, 58, 1068 (1939).
[16] Crabtree, H. G., *Biochem. J.*, 22, 1289 (1928).
[17] *Ann. Rep. Brit. Emp. Cancer Campaign*, 16, 215 (1939).

THE above letter contains two conflicting statements.

(1) "Aerobic glycolysis is not specific for tumours, though practically all tumours have strong aerobic glycolysis." This from Dr. Dickens's report of 1936 seems to be a fair and true statement of the position and not consistent with the following statement from the 1939 report, which I consider "rather misleading".

(2) "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. Firstly the ability of cancer cells to form lactic acid persists even when the tissue is respiring."

Benign growths and most body tissues (with some exceptions, such as kidney cortex, spleen, ovary and lung) which have been carefully examined appear to have some aerobic glycolysis (for example, testis $Q_L^{O_2}$ 2·8–5·5, liver 0·9–4·3, uterus 3·0–6·9). Some of these non-malignant tissues, in addition to the three mentioned by Dr. Dickens, also have a lowered *R.Q.* A few malignant tumours, particularly some human carcinomata[1] and some spontaneous carcinomata in mice[2], have lower aerobic glycolysis than many 'normal' tissues.

There can be no doubt that the British Empire Cancer Campaign has in this, as in so many other problems connected with cancer, given most valuable help by securing the thorough investigation of the question in several different laboratories.

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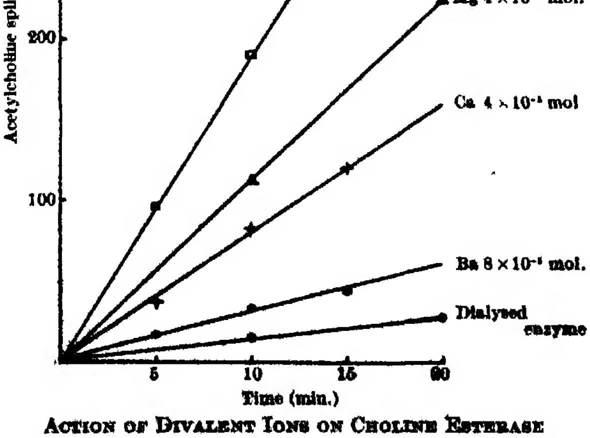
The Royal Cancer Hospital (Free),
London, S.W.3.
Feb. 29.

[1] Dickens, F., and Pattev, D. H., *Lancet*, 2, 1229 (1930).
[2] Murphy, J. B., and Hawkins, J. A., *J. Gen. Physiol.*, 8, 115 (1925).

Action of Ions on Choline Esterase

THE physiological significance of choline esterase suggested by its high concentration at muscle end plates and at synapses of the central nervous system[1] makes it desirable to investigate the properties of the enzyme. The electric organ of Torpedo, which is considered as an accumulation of muscle end plates, has by far the highest content of choline esterase ever found in a tissue of fluid. An organ of 100–200 gm. weight splits about 200–400 gm. acetylcholine in 60 min., which is a hydrolytic power of the



ACTION OF DIVALENT IONS ON CHOLINE ESTERASE

same order of magnitude as calculated for end plates. The organ has therefore been used as material for the preparation of active enzyme solutions[3].

Evidence obtained previously from these preparations indicated that the enzyme contains —SH groups essential for its activity[3]. The present investigations show that the enzyme is only active in the presence of divalent cations. After dialysis the enzyme practically completely loses its activity. A few γ of divalent ions reactivate it. The order of activation by the ions is as follows: Ba^{++}, Ca^{++}, Mg^{++}, Mn^{++} (see accompanying figure). Mn^{++} in a concentration of 0·00002 mol. (1·1 γ per c.c.) increased the amount of acetylcholine split in 60 min. from 0·08 to 1·13 mgm.

Meyerhof's co-workers described a strong effect of Mn^{++} on the action of cozymase[4] and cocarboxylase[5]. Mg^{++} was also active but to a smaller extent. v. Euler and his associates[6] observed that *iso*-citric dehydrogenase does not act unless Mn^{++} or Mg^{++} are present. In all three enzyme systems concentrations of the ions and relationships between the strength of Mn^{++} and Mg^{++} were similar to those described here.

The reactivation by cations occurs at a point different from that at which the reactivation by reduction of S–S groups takes place. The maximal effect of glutathione plus Mg^{++} is equal to the sum of the effects of each alone (see accompanying table).

SUM OF EFFECTS OF Mg^{++} AND GLUTATHIONE. MGM. ACETYLCHOLINE SPLIT IN 60 MIN.

	Values obtained	Calculated values
Dialysed enzyme	0 45	0 45
+ GSH 0 0003 mol	2 20	+ 1 75
+ GSH 0·001 mol	2 30	
+ Mg^{++} 0 002 mol	1 85	+ 1 40
+ Mg^{++} 0 002 mol + GSH 0 0003 mol	3 67	3 60

Monovalent ions (Na,K) also reactivate the enzyme, but only at very high concentrations (0·1 mol.). However, even at such high concentrations the effect of the monovalent ions is much less than that of divalent ions. No difference has been found between K^+ and Na^+.

Our results and conclusions are in contrast to those recently described by Mendel *et al.*[7]. It should be borne in mind, however, that the enzyme preparations employed by those authors were obtained from horse serum and that they appear to have been less active and of a lower degree of purity than those previously described[3].

This work was aided by a grant of the Dazian Foundation.

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School of Medicine,
Yale University.
Feb. 7.

[1] Nachmansohn, D., *Bull. Soc. Chim. Biol.*, **21**, 761 (1939).

[2] Nachmansohn, D., and Lederer, E., *C.R. Soc. Biol. Paris*, **130**, 321 (1939).

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Ice Formation in Worcestershire

ON January 27, when the great snowstorm was developing, the Evesham district experienced a relatively light fall and this changed at night to 'supercooled' rain. Sunday, January 28, found us awaking to a strange 'creaking' of trees in the wind due, I found, to an armour of thick ice. Most of the ice was on top—my aerial had ¾ in. above, ¼ in. below. Wider exploration presented an amazing experience. Roads, walls, trees, hedges—everything was coated with inches of crystal clear ice. Branches and twigs were encased in ice many times their own diameter, and many were, like the telegraph wires in the accompanying illustration, either broken down or

snapping as I passed. Slight rain was still falling and freezing instantly. There seems no doubt that rain had been falling all night in a 'supercooled' state, contact with objects initiating solidification, generally complete before the water could run underneath. People were chiselling their way into cars left outside, and ice on one near Broadway Tower was 6 in. thick.

I saw wood-pigeons, encased in ice as they roosted, hobbling through the grass. Presumably with the receipt of latent heat they had realized nothing untoward until attempting to fly. Roads themselves were sheets of ice—6 in. thick on Broadway Hill—and being used as skating rinks.

Quantitatively—ice 4 in. thick on twigs common, 'blades' of grass 4 in. thick; I measured one telegraph pole guy 18 in. in circumference; one branch weighed

before and after thawing gave ratio 64 to 1, and on one fine grass blade the ice weighed 197 times the grass.

The whole appearance of the countryside was fantastic and grotesque, and it would be interesting to know if any previous similar occurrence is on record

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Optical Anisotropy of Cellulosic Sheets

THE following observations on the optical anisotropy of cellulose ester sheets may supplement the findings of Drummond[1]

Whether the 'slow ray' in the plane of the sheet is normal to, or coincident with, the direction of stress depends on the hydroxyl content of the ester, and, to a lesser extent, on the solvent content of the sheet when stress is applied.

Increasing hydroxyl content favours the same direction as that of the stress, whereas, as surmised by Drummond, introduction of acyl groups favours the normal direction. Thus, with cellulose acetates, the acetyl contents of which are greater than 43 per cent, the slow ray direction may be normal to the direction of stress; similar behaviour is also shown by cellulose nitrate sheets

Within a certain range of hydroxyl contents, in acetate and in nitrate sheets the amount of solvent or imbibed liquid when tension is applied may influence the position of the slow ray. In general, the slow ray lies normal to the direction of stress if tension is applied to a sheet which contains a large proportion of solvent, whereas removal of the latter favours its location in the direction of the applied stress

The extrapolation of birefringence values of cellulose ester sheets to zero acetyl content by Drummond finds some justification from measurements made on uniaxial cellulose acetate sheets, where the increase in negative birefringence is approximately linear with a decrease from 44·8 to 27·0 per cent acetyl. This is more strictly the case in the triacetate region, provided a solvent is selected which gives relatively flexible sheets, and that esters of similar chain-length are employed. As might be anticipated, increase of chain-length increases the negative birefringence.

A detailed discussion of these results will be published elsewhere.

It may be opportune to emphasize here that this method of sheet birefringence determination[2] in its more accurate form is restricted to sheets of relatively low values of birefringence such as those which lie beyond the sensitivity of immersion methods. The method is essentially an approximation in two respects, first, in the assumption of identity of path of the two components in transmission through the sheet, and secondly, in the inherent approximation of the graphical extrapolation.

JOHN SPENCE.

Research Laboratories,
Eastman Kodak Company,
Rochester, N.Y. Feb. 15

[1] Drummond, D. G., NATURE 145, 67 (1940)
[2] Spence, J., *J. Phys. Chem.*, 43, 865 (1939)

Structure of Cellulose Acetate

RECENTLY I have examined several samples of cast plasticized secondary cellulose acetate sheet material under the microscope. With crossed nicols a uniform yellow polarization colour was shown, indicating a considerable amount of orientation. Taking the casting flow-lines, parallel to the 'selvedge' edge, as the direction of the c axis, the samples showed oblique extinction. This phenomenon is consistent with the view that the cellulose acetate unit, and also the parent cellulose, is monoclinic rather than orthorhombic.

C. A. REDFARN.

Quality House, Quality Court,
Chancery Lane,
London, W.C.2 March 6

Points from Foregoing Letters

L. Jánossy and P. Ingleby have carried out counter experiments which give evidence for the occurrence of penetrating showers distinctly different from cascades or knock-on showers. Parts of the showers may possibly be accounted for by assuming the creation of mesons in lead

Mechanical pressure on the eye causes temporary blindness through retinal anoxæmia. K. J. W. Craik finds that after-images of a light exposed to the eye in this condition can be seen on releasing the pressure. This appears to demonstrate their retinal origin, since the stimulation from the primary image has never reached the visual centres in the brain.

In a reply by F. Dickens to a recent comment by Boyland, it is pointed out that although the association of a lowered respiratory quotient with a strong aerobic glycolysis is no longer considered as strictly specific to tumour metabolism, the occurrence among normal tissues of this combination is exceptional enough for it to remain the most characteristic of the known biochemical features of cancer. Dr. Boyland replies that, in his opinion, as this combination does recur in some cases, it is undesirable to say that tumours differ from non-malignant tissues in these properties.

Using enzyme preparations obtained from the electric organ of Torpedo, D. Nachmansohn finds that choline esterase is only active in the presence of divalent cations. Monovalent cations will reactivate the enzyme, but only at very high concentrations.

J. Spence points out, in regard to the anisotropy of cellulose sheets, that the hydroxyl content of the cellulose ester and the solvent content of the sheet influence the orientation of the slow ray in the plane of the stressed sheet. Uniaxial cellulose acetate sheets show, within limits, a linear increase in negative birefringence with increasing hydroxyl content.

RESEARCH ITEMS

Pleistocene and Prehistory in Europe and China

EXTENSIVE research by Wen-Chung Pei in the Chinese Pleistocene and comparison with corresponding results of European geologists and archæologists is summarized in "An Attempted Correlation of Quaternary Geology, Palæontology and Prehistory in Europe and China" (Institute of Archæology, University of London. Occasional Paper No. 2, 1939. Pp. 16+2 tables. 2*s*. 6*d*.). The object of the investigation was to arrive at the age of Sinanthropus, which is here assigned to the Lower Pleistocene in spite of the lithic industry, which exhibits a few features that in Europe do not appear until later. From the point of view of human evolution Sinanthropus would be contemporary with the European Eoanthropus and *Homo Heidelbergensis*. While the European Quaternary covers four main periods of cold climate, in China four physiographic cycles may be observed in which phases of erosion alternated with phases of sedimentation. From the geological point of view, Europe and China have two series of Pleistocene deposits in common, the older covering the period from late Pliocene to early Pleistocene, the younger characterized by the frequent occurrence of loessic material. These two series can be correlated in Europe and in China stratigraphically, lithologically and faunistically; but it is impossible to go further and into detail. It is premature, therefore, to base a correlation on geological evidence only. A purely palæontological basis, notwithstanding difficulties, is more satisfactory. The early Saumenian corresponds to Villafranchian, Choukoutien (Sinanthropus level) to Cromerian, Choukoutien III to early middle Pleistocene, Sjara-Osso-gol (Ordos) to Neanderthal, and Choukoutien Upper Cave to European Upper Palæolithic Prehistory helps little, owing to differences of workmanship, but subject to this proviso, Choukoutien loc. 13 is contemporary with Abbevillian, Choukoutien loc. 15 with early Acheulean, early Clactonian and Tayacian, Ordos with middle and late Acheulean, Micoque, early and middle Levalloisian and Mousterian, and Choukoutien Upper Cave with upper Palæolithic—Aurignacian, Solutrean and Magdalenian.

Insulin Hypoglycæmia and the Central Nervous System

ERNST GELLHORN reported his investigations on the effects on the central nervous system of insulin hypoglycæmia before the recent meeting of the American Association. There is a close interrelationship between its effects and those of cerebral anoxia, in that the two states are mutually synergistic, and in both there is depressed cortical but augmented autonomic excitability. The resultant increased activity of the sympathetic system tends to restore the blood-sugar level, and at the same time to render the medullary centres less excitable, in this case by a direct action upon them of circulating adrenalin. Such reactions tend to restore the animal to its resting state, but may, under slightly different conditions, aggravate the effects of the changes. Thus, prolonged anoxia may prevent hypoglycæmic convulsions, but may also prevent the eventual restoration of a normal blood-sugar level by depressing the mobilization of the hepatic stores of glycogen.

Inheritance of Bobbed Hair

S. E. STODDARD (*J. Hered.*, 130, 543–545; 1940) reports a pedigree in man showing the inheritance as an autosomal dominant of a short fore-lock. The hairs of the fore-lock on the head of the affected individuals grow to five or six inches and then fall out, being replaced by new hairs which again reach 5½ inches and then fall out. This self-bobbing characteristic is to be called 'catatrichy'.

The Oldest Vertebrate Egg

FOSSIL reptilian eggs have been recorded from Cretaceous and Jurassic deposits, but they are rare, and the most striking discovery hitherto was the nest of dinosaur eggs found in the Desert of Gobi by Dr. Roy Chapman Andrews and his fellow-explorers. All earlier records are, however, much antedated by the discovery of an egg, 59 mm. long, at Rattlesnake Canyon, Archer Co., Texas, in rocks which lie close to the boundary between Carboniferous and Permian. Prof. Alfred S. Romer and Llewellyn I. Price describe the shell, almost 1 mm. thick, as ornamented with small rounded tubercles, and in section showing lamellæ, typical of amniote egg-shells (*Amer. J. Sci.*, 237, 826; 1939). The interior, as examined by X-ray photographs, showed no indication of embryonic development. Although it is impossible to say to what reptile the egg must be assigned, the most abundant of the four common reptiles of the Red-beds of Texas is the pelycosaur Ophiacodon (Theropleura), and the "chances are perhaps somewhat in its favor as the possible progenitor".

Growth Hormones in Seed Dressings

H E. Croxall and L. Ogilvie (*J. Pom. and Hort. Sci.*, 17, 362; 1940) have shown that the application to pea and bean seeds of dry fungicidal dressings containing growth-promoting substances may be of considerable value. The vegetative growth of several different varieties of pea plants was stimulated by such treatments, but there was no difference in time of flowering. The dressings used consisted of talc, a proprietary mercurial dressing, and cuprous oxide, containing 5–20 parts per million of naphthalene acetic acid, mixed naphthylidene acetic acids and indolyl butyric acid. The rate of emergence of pea seeds sown in sterile soil in the greenhouse was accelerated, and the dry weight of the seedlings after three weeks growth was increased, by treating the seeds with the above dressings. In certain conditions, the development of some varieties of peas was checked by mercurial and cuprous oxide dressings. This check was partly or entirely overcome by the incorporation of growth substances. In field trials in summer, mercurial and cuprous oxide dressings alone reduced the crop when the soil was dry for a long period, but dressings containing growth substances gave yields up to 80 per cent greater than those from untreated seeds. In greenhouse soil contaminated with damping-off fungi, a higher percentage emergence from several varieties of peas, and one of dwarf beans, was obtained by treating the seeds with hormone-containing dressings than by the use of the same dressings without hormones. There was considerable difference in the response of different varieties to the dressings used.

Two Distinct Diaphorases

COENZYME-SPECIFIC dehydrogenases catalysing the oxidation of tissue metabolites such as lactic acid may require the presence of coenzyme I (diphosphopyridine nucleotide) or coenzyme II (triphosphopyridine nucleotide). Reduced coenzymes I and II do not by themselves react with oxygen, and a further link has been made by the demonstration of the presence in animal tissues of a 'coenzyme oxidase', named by Euler 'diaphorase' and by Dewan and Green 'coenzyme factor', which catalyses the oxidation of these reduced coenzymes I and II. Also, cytochromes *-a* and *-b* are rapidly reduced by the diaphorase – coenzyme system and re-oxidized by cytochrome oxidase and oxygen. The complete system for lactate is thus:

$$\text{Lactate} \xrightarrow[\text{dehydrogenase}]{} \text{Coenzyme} \xrightarrow[\text{diaphorase}]{} \text{Cytochromes -}a\text{ and -}b \xrightarrow[\text{cytochrome oxidase}]{} \text{Oxygen}$$

(arrows show the direction of hydrogen transfer) Straub, Corran and Green showed that diaphorase is identical with a flavoprotein isolated from heart muscle containing flavin-adenine-dinucleotide as prosthetic group. E. P. Abraham and E. Adler (*Biochem J.*, **34**, 119; 1940) have now confirmed that there are two distinct diaphorases having activities with respect to coenzyme I and coenzyme II. Thus diaphorase from heart has only diaphorase I activity, and that from acetone-dried adrenal possesses also diaphorase II activity, and the ratio of the activities of diaphorase II and diaphorase I varies widely for different tissues.

Evaluation of *e*, *m* and *h*

AN important paper on the evaluation of the electronic charge and mass and the quantum of action was read by C. G. Darwin at a meeting of the Physical Society on February 9, and is appearing in the March issue of that Society's *Proceedings*. This subject has recently been discussed by Dunnington in *Reviews of Modern Physics* and by Du Mond in the *Physical Review*. The aim in each case is to derive the best possible values of *e*, *m* and *h* by combining all the different experimental data. By considering the logarithms of the quantities concerned rather than the quantities themselves, Darwin develops a method which is simpler than Dunnington's and might well be adopted in any future revision of the constants. Du Mond takes much the same point of view, but where his method is approximate, Darwin's is exact. Darwin agrees with the other two investigators in concluding that there is a discrepancy between the direct determination of h/e and the other experimental methods. There has probably been some unknown systematic error in the determinations of the limit of the X-ray continuous spectrum, unless, as is far less likely, there are systematic errors in several of the other experiments which happen to give concordant fallacious values. The final results are: $e = 4{\cdot}8025 \times 10^{-10}$, $e/mc = 1{\cdot}7591 \times 10^{7}$ and $h = 6{\cdot}6243 \times 10^{-27}$, the probable error being about one in ten thousand in each case. With these values the fine-structure constant $hc/2\pi e^2$ is 137·03, with probable error about 0·03.

The Study of Atmospherics

T. H. Laby, J. J. McNeill, F. G. Nicholls and A. F. B. Nickson (*Proc. Roy. Soc.*, A, **174**, 145) have carried out a series of investigations of atmospherics, using an aperiodic aerial connected through an amplifier to a self-recording cathode-ray oscillograph. The results confirm those of previous workers that the electric field changes due to a lightning discharge include a slow field change due to the leader stroke, a rapid return stroke, and a final slow non-oscillating change. The disturbance is often followed by waves reflected from the ionosphere. In some cases a damped oscillating discharge was observed, and reasons are given for regarding this as a feature of the discharge rather than a result of successive reflections. A mean value of the peak power in an atmospheric is 5×10^{8} kw., and of the total energy radiated 200 kw. sec. This is small compared with the total energy of a thundercloud.

An Auto-collimating Spectrohelioscope

M. A. ELLISON has described very fully a home-made spectrohelioscope (*J. Brit. Astro. Assoc.*, **50**, 3; 1940). The instrument took Mr. Ellison 2½ years to construct. A clear explanation with numerous diagrams is provided, and those who are interested in the subject should study the paper carefully. It is satisfactory to know that the performance of the instrument has come up to expectations, and most of the chromospheric details in $H\alpha$ light visible in the Hale instruments are shown. The performance is particularly good with limb prominences.

Spectrum of Nova Aquilæ (1918)

A DETAILED examination of the spectrum of Nova Aquilæ has been made by Arthur B. Wyse (*Pub. Lick Observatory*, **14**, Pt. 3) and is a valuable contribution to data already published by a number of other workers on this interesting nova. Nova Aquilæ is the only nova of which the pre-nova stage spectrum is known. As a star of about mag. 10·5, its spectrum appears as approximately of Class *A* on the Harvard plates taken about thirty years before the outburst. With a rapid rise in brightness commencing on June 7, 1918, it reached a maximum brilliance of mag. – 1·1 by June 9·9. (It is the brightest nova since Nova Ophiuchi in 1604.) At the present time it is a star of about mag. 10·8. Another interesting feature of this nova was the subsequent appearance of an expanding luminous disk discovered by Barnard three and a half months after the outburst on June 7. Later measurements made by Aitken gave a rate of angular expansion of about 2″ a year. Combining with this value the measured Doppler shifts representing radial motion, a distance of about 360 parsecs or 1,200 light years is derived. The absolute luminosity of the nova at maximum was of the order 300,000 times that of the sun. The spectrograms which form the basis of the present work were taken at the Lick Observatory, but because of the rapid changes in spectrum during the active stages of the nova, spectrograms from a number of other observatories (Mt. Wilson, Cape of Good Hope, Cambridge, etc.) form a valuable link in the daily journal of the spectrum which Dr. Wyse has prepared. Reference must be made to the text for details of the changing absorption and emission spectra. There were three absorption spectra recognized in the order of appearance, I, II and III, on June 8, 10 and 11 respectively. This order also represents the relative magnitudes of the Doppler displacements of the spectral lines towards the violet. The chief points of interest in the emission spectrum include the oscillatory change in the profiles of the bands during the few weeks following the outburst, and also the peculiar distribution of light in the various emission bands in the spectrum of the expanding nebulous envelope.

INTERNATIONAL HEALTH INVESTIGATIONS

THE report to the Council of the League of Nations on the work of the thirty-first session of the Health Committee, November 20–24, 1939 (Special Supplement to Monthly Summary of the League of Nations, January, 1940), emphasizes the important duties of the Health Organisation under war-time conditions, particularly in view of the threats to health from movement of populations and evacuation.

The Committee agreed that the permanent health services should not be interrupted, particularly the Epidemiological Intelligence Service, the Singapore Bureau and the biological standardization work, the utility of which is universally acknowledged. It is also desirable to continue studies on which a considerable amount of work has already been carried out, such as the inquiry into the radiological treatment of cancer of the cervix uteri, the preparation for the unification of the various national pharmacopœias, the studies undertaken by the Malaria Commission on malaria immunity, and the biology of certain strains of Plasmodium, the co-ordination of investigations into nutrition in the East, and the analysis of the annual statistics of rabies The Committee also considers that national committees and national institutes should be urged to continue their work on nutrition, physical fitness and housing, for which the Health Section will ensure the necessary liaison and co-ordination It was considered that comparatively new studies, such as museums of hygiene, clothing and the preparation of an international list of diseases, must be relegated to the background for the present, and it was agreed that the impending Pan-African Health Conference should be deferred until the end of the War. The Anti-malarial Drug Conference and the Rabies Conference have been similarly deferred

In view of the repercussions the present War is likely to have on public health, the Health Committee considers that attention should be devoted to such questions as the importation of diseases into regions hitherto free, the possible contamination of drinking water, and lower standards of living and hygiene. The Emergency Sub-Committee and the Health Section have accordingly been authorized to take such action as circumstances require, including a stocktaking of the armoury of preventive and curative weapons made possible by modern epidemiology, chemotherapy and serotherapy The Health Section proposes to define the principles which should be followed in the control of those epidemic diseases which are regarded as the most important in present circumstances, for example, immunization against diphtheria and scarlet fever Other questions to which the Health Organization is prepared to give attention are the medico-social problems arising out of the evacuation of threatened populations from war zones, including questions of environmental hygiene among evacuated persons living in the reception areas and individual standards of hygiene, as well as problems of food supply requiring the application of the rules of modern dietetics in the use of foodstuffs and in collective and individual dietaries. In view of the considerably increased volume of work anticipated, the Committee directed the Secretary-General's attention to the desirability of making at least some temporary increase in the staff.

The introduction of international biological standards by the Copenhagen and Hampstead Institutes has continued normally, and the number of institutes using these standards has increased. The Health Committee once more directed attention to the recommendation adopted by the Permanent Commission on Biological Standardisation in 1928 regarding nomenclature to be used in the designation of blood groups.

The report of the Housing Committee, which met at Geneva during June 26–July 1, 1939, to discuss the hygiene of the planning of space, the abatement of smoke, dust and toxic gases, water supply, sewage treatment, and the collection and treatment of domestic refuse, is being communicated to Governments, health administrations and the institutions concerned.

RECENT AMERICAN WORK ON PLANT VIRUSES

THE meeting of the American Association for the Advancement of Science, which was held at Columbus, Ohio, in December, was the occasion for the presentation of several interesting papers which make fundamental contributions to our knowledge of plant virus diseases. The first categorical indication of structure of the virus particle can be obtained from a comparison of the work of John W. Gowen, of Iowa State College, with earlier findings. His work on X-ray inactivation and size of various organisms, including insects, bacteria and viruses, shows that functional correlation of these two factors "must be between the size of some vital substances within the cell rather than the cell as a whole". The 'reproductive' part of a virus particle has a molecular weight of 15,000,000, which compares with about 7,000,000 suggested by other workers for the whole virus particle. The portion of a virus susceptible to inactivation by X-rays is apparently denser than the rest of the particle.

Vernon L. Frampton, of Cornell University, showed that the protein of tobacco mosaic virus is thixotropic; it forms a colloidal sol, but can change to the fluid state if it is agitated. The report consisted of motion pictures which recorded the birefringence of the sol as observed through polaroid plates. Thixotropic gels show neither Brownian movement, diffusion nor osmotic phenomena, and it is pointed

out that any attempt to determine molecular weight of the protein by any of these means would yield abnormally large values

In the sphere of host-virus relations, Ernest L. Spencer, of the Rockefeller Institute for Medical Research, demonstrated that the rate of virus multiplication is closely bound with the nitrogen metabolism of the host Tobacco plants growing in pure culture, and supplied with a relatively large amount of nitrogen, allowed the virus to attain about five times the concentration found in normally fed plants. The effect was not due to an increased growth-rate of the plant, and it was also demonstrated with older seedlings. James M. Wallace, of Riverside, California, dealt with the development of resistance to the curly top virus of Turkish tobacco. He showed that plants recover from an attack by the virus, a certain time after inoculation. Such plants, when re-inoculated, do not again develop severe symptoms. Transmission from a recovered to a healthy plant by means of insect vectors induced severe symptoms in the healthy plants, but grafting merely transferred the mild symptoms typical of the recovered plants. Resistance, therefore, appears to be due to some interaction which is set up between host and virus.

INDIAN SCIENCE CONGRESS ASSOCIATION*

MADRAS MEETING

ASPECTS OF THE MYXOPHYCEÆ

Prof. Y. Bhâradwâja, presiding over the Section of Botany, considered the peculiar group of algæ known as the Myxophyceæ. These algæ present many problems, both economic and botanical, and in spite of the extensive literature there is scarcely any authoritative statement that can be made concerning any aspect of their study at the present time. Owing to the peculiar properties of their cells, many of them are able to exist under high-temperature conditions and are largely tropical in their distribution, so that India is a particularly suitable centre for their study. With the active investigations that are being carried out by Prof Bhâradwâja and other algologists at Madras, Lahore and Benares, it is hoped that much light will be thrown upon their peculiar features.

A special interest of this group for India is the way in which the Myxophyceæ at times undergo extreme development and give rise to the condition known as 'water-bloom'. On death and decay, such masses of algæ give disagreeable tastes and odours to the water and may render it unfit for drinking purposes, in fact there are records from many parts of the world of serious effects produced upon man and animals by drinking such water. In India, water-blooms are of common occurrence in ponds, pools and tanks, the water of which is used for consumption by humans and domesticated animals; though no serious effects have so far resulted in India, it is obviously a subject requiring investigation. Such points as the conditions favouring the development of the blooms, the contributing organisms, methods of control, and the manner in which the organisms persist all require workers in India.

Prof. Bhâradwâja also directed attention to the problems played by Myxophyceæ in soil ecology. These algæ occur in considerable numbers in the soil flora and some of them, notably Nostoc and Anabæna, are capable of nitrogen-fixation. In the Indian rice fields, the same crop is grown year after year without addition of manure, and it has been discussed whether the abundant development of these algæ during inundation may be a factor of any importance. Fritsch and De came to the conclusion that their part in this connexion was probably relatively insignificant, but the problem needs further study.

The Myxophyceæ are also in need of closer study and revision from the botanical point of view. In many cases the generic distinctions are unsatisfactory, as they are not applied logically and allow of too much intergrading Their cytology has received considerable attention lately and most workers are now agreed that the central body may be regarded as a nucleus

Systematic study of the group involves such problems as their relation to the isolated group of the Chamæsiphonales and also to the Bacteria, especially such types as the sulphur bacteria.

Prof. Bhâradwâja's address points out the wide scope for workers in this field, and his survey of the present position of knowledge of the group will be a valuable basis for anyone attracted to further the study of the Myxophyceæ.

AIR-BREATHING FISHES

The presidential address to the Section of Zoology was delivered by Prof. B. K. Das.

In a comprehensive survey of present knowledge of the phenomenon of 'air-breathing' in fishes, Prof. Das developed the theory of structural adaptation in response to environmental change. "The habit of swallowing air," he says, "being long continued, becomes deeply engrained in the constitution of the species, generations after generations, and is gradually improved and eventually leads to structural modifications, usually in the form of reservoirs adapted to lodge the inhaled air. These reservoirs are of very different forms and quite independently evolved, in each and every species of fish. . . ."

Six main types were described of progressive adaptations, which are to be seen in modern air-breathing fishes, namely, modifications of the buccopharynx; pharyngeal 'lung'; opercular chambers; opercular 'lung'; specialized parts of the alimentary canal (stomach and intestine); and the air-bladder. These accessory respiratory organs are regarded as the physiological forerunners of the true lungs of the terrestrial vertebrates, evolved in consequence of a lack of oxygen in the water.

The views of Carter and Beadle are supported and quoted verbatim: ". . . A power of breathing air must have been a necessary preliminary to the possibility of migration to land. It appears probable

*Continued from page 471.

that the development or the preservation of aerial respiration in fishes of the tropical fresh waters was a response to the shortage of oxygen in the water, and that it occurred while the fish was still purely aquatic. The fish was then ready for the later changes which completed the migration. The stimulus for these was probably provided by the droughts to which any animal living in such waters must have been subjected. That this has been the course of the later stages of the migration on to the land is generally accepted, but it does not seem to have been so generally realized that the first stage in the process of migration was the evolution of adaptations to aerial respiration, first instigated by the lack of oxygen in the shallow tropical fresh waters in which the fish lived."

This presidential address in its printed form, with its extensive bibliography and liberal quotations from the work of other investigators, is to be welcomed as a helpful handbook of reference to a subject of general biological interest.

Ecology and Control of Insects

Dr. Hem Singh Pruthi, in his presidential address to the Section of Entomology, discussed the general principles of insect ecology and, in particular, the application of such knowledge to insect control. As he pointed out, if we know the conditions of environment of an insect pest and the influence of changes thereof on its population, it may be possible to predict the outbreak of the pest in advance or to evolve methods which would keep the injurious species under control. Of the various physical factors of environment, temperature is undoubtedly the most important single agency. In order to illustrate the influence of this factor and to indicate how such information can be utilized by applied entomologists, examples are given of Zwolfer's critical work on the nun moth, *Lymantra monacha*, of Bodenheimer's studies on the Mediterranean fruit-fly and of several other works.

Next in importance to heat, the fundamental necessity of insects, as of other animals, is the moisture content of their environment. Too low or too high humidity is injurious to their existence. On the basis of such information, the Imperial Agricultural Research Institute has shown that good and well-spread rains do not reduce the spotted boll worms of cotton directly, but indirectly by raising the atmospheric humidity, which is inimical to the bollworm and conducive to the multiplication of its parasite *Microbracon lefroyi*. Afzal Husain and Haroon Khan's work on the ecology of pink bollworm of cotton in the Punjab illustrates the combined effect of temperature and humidity on insect prevalence. They found that temperatures between about 18° C. and 26° C., with a relative humidity of more than 70 per cent, are most suitable for egg production and oviposition. Those parts of the Punjab where temperature and humidity conditions approach the above figures during July–October, which is the active period of the pest, are badly infested with the bollworm, while in canal colonies and the western Punjab, where the conditions are different, the pink bollworm does not occur as a pest. physical

Insects are not only exposed to climatic factors but also to biotic factors such as parasites, predators, competitors, types of surrounding vegetation, etc. The importance of natural enemies in reducing the population of insect pests is well known and is being exploited by workers on biological control of pests. The basic principle underlying this method is the differential behaviour of a pest and its parasite under the same ecological conditions. This is illustrated by Shelford's work on the aphid, *Toxoptera graminum* and its parasite, *Lysiphlebus tritici*, and by the researches of several other workers. Even small differences in the rates of development of the host and parasite may cause the extinction of one or the other.

The control of malaria-transmitting mosquitoes by ecological methods has had undoubted success in certain areas and has possibilities of more general application. The fact that most of the vector Anophelines do not breed in sewage-polluted waters is exploited by turning industrial wastes, etc., into clean breeding waters. On the same principle the filling of pools and streams with cut vegetation, termed 'herbage package', which not only acts as mechanical obstruction but also pollutes the water, and brings about other changes, has been made use of as an anti-malarial method. Strickland recently showed that streams shaded by forests, in Assam, breed only non-vector harmless mosquitoes, and when these shades are cleared the malaria-carrying species at once appears and begins to breed. Therefore, shading of streams by growing low hedges of lantana, etc., is being extensively practised in India, Malaya and other countries. These observations also emphasize the necessity of preserving original shade and adding more trees to natural jungle as an anti-malaria measure.

Dr. Pruthi's address, it may be added, is well documented with a bibliography of the literature bearing upon the subjects under discussion.

Anthropological and Archæological Studies in India

The presidential address to the Section of Anthropology was delivered by Rao Bahadur K. N. Dikshit, who discussed "The Scope of Prehistoric and Anthropological Work in India".

It is to be hoped that the association between archæology and anthropology which has been exemplified in this session of the Indian Science Congress will be a more abiding one, and will react to the mutual advantage of both the sciences, and that all universities and research institutions, which have provided facilities for work in one, will always extend them to the other branch of humanistic studies. In this vast country there is unlimited scope for these studies, and the danger from the extension of cultivation and rural expansion in a more sophisticated mode of life is equally felt by both. It is, therefore, all the more necessary that the future research programme should be speeded up and properly co-ordinated.

So far as expenditure is concerned, although archæology looms somewhat large among the scientific departments of the Government of India, an infinitesimal amount is available for expenditure on work of a scientific character. The personnel ought to be strengthened with a view to the extension of scientific activities in prehistoric archæology and anthropology. Many of the museums are doing good work in the educational sphere, but there is scarcely any scope for the acquisition of scientific knowledge regarding man and very few research facilities.

Sir Leonard Woolley has directed attention to the want of sufficient contact between the Archæological Department and the anthropologist. He has

suggested the possibility of unravelling the problems of the past by significant survivals among existing peoples, as, for example, the ancient burial customs in South India. A common plan pursued by workers in the field should, he holds, result in a more intelligent collection of anthropological material, and the task of the archæologist would be made simpler if the museums of India were to collect and preserve, not only ancient pottery and handiwork, but also that produced up to to-day by the primitive peoples of India. The idea of a central ethnological museum in New Delhi unfortunately has been allowed to lapse, and India is still without either an anthropological, ethnological or archæological central museum.

Turning to the field of prehistoric archæology, it is now more than seventy years ago that the first human artefacts associated with the bones of extinct mammals were found in the cliffs of the Nerbada and the Godaveri. It is unfortunate that further investigations were not carried on in the light of new discoveries in every part of the world. The attention of the Government and the universities should be directed towards the necessity of the systematic conduct of such work under trained prehistorians. It is unfortunate that the systematic survey of the Yale-Cambridge expedition under Dr. H. de Terra has not been continued.

The most interesting and well-developed phase of the prehistoric civilization of India undoubtedly is that represented by Harappa and Mohenjo-daro. It is unfortunate that there is no prospect of further work in this field to discover tribes with earlier and later cultures. Further systematic work at Dambbuthi would be rewarded with rich results unravelling an earlier civilization than Mohenjo-daro, whereas bridging the gap between Mohenjo-daro and later civilizations will occupy generations of workers.

The problem of Aryan invasion has as yet received no light from excavation in Sind and the Punjab, while the proper study of the sequence of metallurgical knowledge has yet to be established, and the place of the copper culture of the Gangetic valley and the iron industry of, for example, Bellary in the south has yet to be determined. Further research alone will show what the exact relation between the stone and metal ages of North and South India must have been.

In South India, the scope for work is greater owing to the abundance of material suitable for the manufacture of tools for palæolithic and neolithic man; while in every district one or other phase of pre- and protohistory is present in examples which must be systematically studied before many of them meet destruction at the hand of man. Among such subjects of research are the rock-shelters and the rock-paintings and carvings which lead up to the culminating splendours of Ajanta and Bagh.

One of the greatest difficulties facing the physical anthropologist in India is that of obtaining material for determining the racial characteristics of the ancient people of their country. The dearth of students in this highly interesting branch of knowledge is very keenly felt. In anthropometry, much interesting work has been done in the various provinces and among the different castes or tribes; but it is no exaggeration to say that barely the fringe of the problem has been touched. For the anthropologist there can be no more interesting country than India to study, although he would probably be overwhelmed by the immensity of the task and the diversity of the material before him. When in India every stage of the entire progress of the human race from the humblest beginnings to the greatest spiritual elevation can be studied with greater ease and facility than in any other country, is it too much to expect that the proud possessors of this wonderful heritage will not neglect their patrimony and will not leave entirely to others the task of studying themselves, their racial composition and age-long cultures?

CROP PRODUCTION IN INDIA

The presidential address to the Section of Agriculture was delivered by Prof. Jai Chand Luthra, who took as his subject "Some Problems of Crop Production in India". Prof. Luthra began by reviewing the condition of Indian agriculture up to the time when the Government took steps to organize some aspects of it on scientific lines, that is about the beginning of the present century. He stressed the fact that India's farm produce is meant primarily for local consumption, and agriculture must therefore remain India's basic industry; there is, however, a demand for the establishment of secondary industries, such as those processing grain for breakfast food.

In the nineteenth century agriculture suffered a setback, of which the chief cause was the indifference of the farmer to the quality of seed. This neglect is of comparatively recent date, for at one time India was famous for the fine quality of its cotton. The merit and the constitutional structure of seed is of fundamental importance in crop husbandry. In India there is no legal safeguard of germination percentage, and pressing need is felt for a Seeds Act. Prof. Luthra reviewed some factors bearing on seed quality. Experiments at Lyallpur have shown that a predominance of yellow in the seed of berseem is an indication of maturity and of good germination; and the proportion of yellow seed bears an inverse relation to the number of cuttings taken from the crop left to seed. A similar correlation of colour to viability has been observed in seeds of shaftal (*Trifolium resupinatum*) and of lucerne.

Selection and breeding have done a great deal for Indian agriculture, but have brought about peculiar difficulties. One of the most important crops of the Punjab and the United Provinces is gram (*Cicer arietinum*). When the two best gram selections, evolved after twenty-five years work, were introduced into cultivation, blight disease was confined to the northern part of the Punjab. For the last four years, gram in other parts of the province has been stricken so severely by blight that one popular selection has been affected up to at least 50 per cent. The growers get alarmed when they find crops damaged by unaccustomed diseases, and it is no wonder if the growers remark that agricultural departments create the diseases. However, in Burma the serious wilt of gram has been overcome by the discovery of a resistant type that now occupies the entire area under that crop.

The wealth of India lies in its innumerable villages; as Tagore has said, "In the keeping of the village lies the cradle of the race". For effecting real improvement in agriculture, it is necessary to take stock of the economic conditions of the farmer. The village is working under many disabilities. There is everywhere an earnest desire that the farmer should raise his standard of living, but so long as he is unable to increase his earning power this will remain a wish. Some measures are necessary for affording relief to the growers of food crops. In the Punjab

the average size of a cultivated holding is scarcely 10 acres, and as many as six or seven persons live on it. Considerable labour is therefore being wasted on an unremunerative occupation.

NUTRITIVE VALUE OF RICE

Dr W. R. Aykroyd devoted his presidential address to the Section of Physiology to the subject of rice. Rice is the staple food of the majority of the population in the provinces of Assam, Bengal, Bihar, Orissa and Madras The diet of many other peoples in the East is also based on rice, in fact, it is stated that rice is the staple food of about half the human race Yet, by modern standards, the rice-eater's diet falls short of such standards in almost every important constituent In India he consumes in addition to his staple cereal, which supplies 80–90 per cent of the total calories, only very small quantities of other foods such as pulses, vegetables, fruits and meat; milk and milk products are taken in negligible quantities or not at all.

Rice, compared with most cereals, has a low protein content, although the proteins are of high biological value. It is poor in fat and carotene, calcium and iron: the amount of phosphorus present is fairly high. Milling reduces all the above constituents; in many parts of India, however, rice is prepared for consumption by hand-pounding, when the losses are less. Hand-pounded rice retains 50–75 per cent of the pericarp, the germ being usually completely removed. Raw rice when milled loses about three-quarters of its vitamin B_1 and two thirds of its nicotinic acid; these losses are considerably reduced if the rice is parboiled first. Parboiling is the steaming or boiling of unhusked rice after soaking; this splits the woody husk and renders its subsequent removal easier. After parboiling, the rice is pounded or milled in the same way as raw rice; during the steaming some of the vitamin B_1 and nicotinic acid diffuses through the grain and cannot be removed by subsequent milling This fact is of great importance and, since most of the rice-eaters in India consume parboiled in preference to raw rice, explains the relative rarity of typical beriberi in most parts of the country. Washing the rice results in further losses of essential foodstuffs The losses are of the following order: *calories*, 15 per cent; *protein*, 10 per cent; iron, 75 per cent; calcium and phosphorus, 50 per cent, vitamin B_1 and nicotinic acid, 40–50 per cent.

Dr. Aykroyd finally considered how rice diets can be improved. He is of the opinion that the development of strains of high nutritive value is unlikely to improve rice diets, since rice will always be deficient in certain food factors He considers the easiest way of raising the nutritive value to be by minimizing the losses brought about by milling, washing and cooking. On the other hand, the introduction of high-yielding strains will reduce the pressure on the land and enable the production of supplementary foods to be increased. When parboiled rice is consumed, there is little difference in nutritive value between hand-pounded and machine-milled, although the former is to be preferred. Highly milled raw rice is a danger to public health, and its use should be discouraged. Dr. Aykroyd suggested that milling beyond a certain degree should be prohibited; a suitable standard might be not less than 1·5 μgm. of vitamin B_1 per gm. Once-polished raw rice has a vitamin B_1 content of this order; use of such a rice would prevent the appearance of beriberi.

Rice must, however, be supplemented by other foodstuffs. Dr. Aykroyd suggested that ragi, a millet, should substitute rice in part, and that the intake of pulses and green leafy vegetables should be increased; the latter supply vitamin A and calcium. Milk is the best supplement to rice diets; if fresh milk is not available, milk reconstituted from skimmed milk powder may be recommended. Milk supplies calcium, or this element can be provided in the form of *calcium lactate*; such a supplement (about one gram daily) definitely improves the state of nutrition of children on a rice diet. Vitamin A can be provided in green leafy vegetables, milk-fat, fish liver oil or red palm oil Dr. Aykroyd suggested that it might be possible to blend the latter with common Indian vegetable oils to produce a palatable product with a vitamin A activity corresponding to that of good butter Finally, he emphasized that the development of an efficient fishing industry would provide India with a valuable supplement to poor rice diets.

PSYCHOLOGY AND EDUCATIONAL RESEARCH

In his presidential address to the Section of Psychology, Dr. D. D. Shendarkar said that although psychology is a comparatively young science, yet it has already found application in many fields, of which education is of vital importance. Results of investigations into such educational problems as scholastic and intelligence tests, examinations, and learning processes, are evidence of the value of psychological methods and knowledge to the efficiency of the teacher Education is becoming more scientific in method The suggestion, though, of practical problems and the testing of the experimental results in actual practice must rest with the teacher. Unfortunately, the psychology taught in training colleges for teachers is often too theoretical, and the young teacher does not see the connexion between the science and the problems of the class-room.

There is an urgent need for a central institute of education where training in research methods could be obtained, and where modern research sources in educational topics would be available for reference. Such a body would serve both as a training and consultative body as well as a centre for research. Although learning is the central problem in education, yet research into the learning processes is inadequate, largely because experiments in learning have been studied in psychological laboratories, and the materials employed have too often been of an artificial nature. Research into testing for intelligence has yielded practical results, and now intelligence tests are used in selection for admission to different types of schools, for vocational guidance, and for diagnosing feeblemindedness and backwardness. The problem of admission to different types of higher secondary schools is in reality one of discovering the type of education most suited to the capacities and interests of the pupils, so that they may be classified according to mental ability rather than according to scholastic attainments. Little, however, is known of the abilities required for the various vocations.

Psychology has made considerable development in regard to children's problems and child guidance, and it attempts to diagnose and treat the underlying causes of the various symptoms instead of dealing with the symptom alone. The utilitarian study of psychology has not, however, kept pace with its academic study; what India needs at the present juncture is that the knowledge available should be applied.

SEVENTY YEARS AGO

NATURE, vol. 1, March 31, 1870

The Size of Atoms

"THE idea of an atom has been so constantly associated with incredible assumptions of infinite strength, absolute rigidity, mystical ations at a distance, and indivisibility, that chemists and many other reasonable naturalists of modern times, losing all patience with it, have dismissed it to the realms of metaphysics, and made it smaller than 'anything we can conceive'." "W.T" then goes on to review the experimental evidence for giving tangible sizes to atoms. He refers to Cauchy's mathematical work, and to investigations on the contact electricity of metals on capillary attraction as shown by soap bubble investigations, on the kinetic theory of gases, and sums up as follows:

"The four lines of argument which I have now indicated, lead all to substantially the same estimate of the dimensions of molecular structure Jointly they establish with what we cannot but regard as a very high degree of probability the conclusion that in any ordinary liquid, transparent solid, or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than the hundred-millionth, and greater than the two thousand-millionth of a centimetre

"To form some conception of the degree of coarse-grainedness indicated by this conclusion, imagine a raindrop, or a globe of glass as large as a pea, to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion. The magnified structure would be coarser grained than a heap of small shot, but probably less coarse grained than a heap of cricket-balls"

Bacterial Warfare

PROF. TYNDALL will have much to answer for in the results that may be expected from the spread of his "dust and disease" theory It is stated by the *Athenæum* that a new idea has been broached in a recent lecture by Mr Bloxam, the lecturer on chemistry to the department of artillery studies. He suggests that the committee on explosives, abandoning gun cotton, should collect the germs of small-pox and similar malignant diseases, in cotton or other dust-collecting substances, and load shells with them. We should then hear of an enemy dislodged from his position by a volley of typhus, or a few rounds of Asiatic cholera. We shall expect to receive the particulars of a new "Sale of Poisons" Act, imposing the strictest regulations on the sale by chemists of packets of "cholera germs" or "small-pox seed". Probably none will be allowed to be sold without bearing the stamp of the Royal Institution, certifying that they have been examined by the microscope and are warranted to be the genuine article.

A COURSE of lectures for women in the science and practice of music, by Mr. Sullivan, will be delivered at South Kensington, under the patronage of the Science and Art Department, shortly after the close of Prof. Oliver's course on botany.

IN speaking of the extinction of species and the struggle for existence, Mr. Darwin uses language which may be literally applied—applied without even verbal modification—to the phenomenon of languages. [From an article by Dean Farrar.]

UNIVERSITY EVENTS

LONDON.—The title of reader in physics in the University has been conferred on Dr F. C. Chalklin, in respect of the post held by him at University College.

The degree of D.Sc. has been conferred on Mr. Hugh Davson (University College), Mr J. L. D'Silva (King's College), Dr. W. H. Newton (University College), Prof. Gilbert Stead (Guy's Hospital Medical School), Mr Albert Wassermann (University College), and that of D.Sc. (Engineering) on Mr R. H. Barfield (Imperial College).

MANCHESTER.—Dr. C. W Wardlaw, officer-in-charge of the Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad, has been appointed Barker professor of cryptogamic botany in succession to Prof. W. H. Lang, who retires at the end of the present session.

READING.—Dr Barbara Colson, formerly research assistant in botany in the University of Manchester, has been appointed lecturer in botany

FORTHCOMING EVENTS

Saturday, March 30

ROYAL PHOTOGRAPHIC SOCIETY, at 3 p.m.—H. Mills Cartwright "Colour Photogravure by the Masking Method".

Tuesday, April 2

ROYAL HORTICULTURAL SOCIETY, at 3 p.m.—Prof F E Weiss "Graft Hybrids and Chimæras" (Masters Memorial Lectures. Succeeding lecture on April 16)

Thursday, April 4

CHEMICAL SOCIETY, at 2.30 p.m.—Annual General Meeting. At 3 p.m.—Sir Robert Robinson "Some Biological Aspects of Organic Chemistry, (a) Recent Progress in Chemotherapy, (b) Structural Relations in the Sterol Group" (Presidential Address). At 5 p.m.—Prof. E. K Rideal "The Sörensen Memorial Lecture"

Friday, April 5

INSTITUTION OF CHEMICAL ENGINEERS (Eighteenth Annual Corporate Meeting, at the Hotel Victoria), at 11.45 a.m.—F Heron Rogers: "Oil" (Presidential Address).

BRITISH PSYCHOLOGICAL SOCIETY (Extended General Meeting), April 5–6

April 5.—Discussion on the Problems of Evacuated Children (Speakers: E M. Bartlett, A. H. Bowley, C. Preston Rawson).

April 6.—Discussion on Propaganda (Rex Knight: "The Technique of Propaganda"; F. M. Austin: "Propaganda and Suggestion").

April 6.—Discussion on So-called War Neuroses (Speakers Millais Culpin, T. A Ross, Edward Glover).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned.

ASSISTANT LECTURER IN MECHANICAL ENGINEERING at the Bradford Technical College—The Director of Education, Town Hall, Bradford (April 6).

GRADUATE TEACHER OF MECHANICAL ENGINEERING SUBJECTS in the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick (April 8).

CHEMIST IN THE WATERWORKS DEPARTMENT—The Secretary, Waterworks Offices, Town Hall, Manchester 2 (April 15)

PROFESSOR OF CHEMISTRY—The Principal, Heriot-Watt College, Edinburgh (April 16).

HEAD OF THE MATRICULATION DEPARTMENT—The Director of Education, The Polytechnic, 309 Regent Street, W.1 (April 16)

TEMPORARY LECTURER in charge of the Department of Physics—The Registrar, University College, Leicester (April 17)

AN ASSISTANT MASTER to teach Geography, Mathematics, Elementary Science and Woodwork at the Rosario English School, Argentine —The British Council, 3 Hanover Street, W.1 (quoting 'Rosario') (April 17)

PRINCIPAL OF THE CEYLON UNIVERSITY COLLEGE—The Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S W.1 (April 30).

TEMPORARY FULL-TIME TEACHER OF ENGINEERING SUBJECTS—The Principal, Technical Institute, Ladywell, Dover.

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S W.1 (quoting M/9114)

ASSISTANT TOWN ENGINEER for the Kumasi Public Health Board Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S W 1 (quoting M/8332)

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society Vol 22 (N S), No 19 The Chemical Constituents of Lichens found in Ireland—*Lecanora gangaleoides*, Part 2 By Dr T. J Nolan and Dr J Keane Pp 199 210 1s. Vol 22 (N.S), No 20 Further Experiments on Transpiration into a Saturated Atmosphere. By Prof Henry H Dixon and J S. Barlee Pp 211-222 + plate 5. 1s. 6d (Edinburgh Robert Grant and Son, Ltd , London Williams and Norgate, Ltd.) [292

West India Royal Commission, 1938-39 Recommendations. (Cmd 6174.) Pp. 30 (London H M. Stationery Office.) 6d. net [292

Statement of Policy on Colonial Development and Welfare (Cmd. 6175) Pp 8. (London H M Stationery Office) 2d net. [292

Liverpool Observatory and Tidal Institute Annual Report, 1939 Pp 14 (Liverpool Liverpool Observatory) [13

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